



IoT for Asset Tracking: On The Ground and From Satellite



Shaping the IoT future



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Introduction

IoT has a major part to play in resolving some of the key challenges in asset tracking.



Asset tracking is proving

to be an increasingly crucial part of business across industries – ensuring the safety and security of assets as well as generating data that can be used to assess operations and inform business decisions. Suppliers increasingly need to know where their assets are at all times and its condition, since late delivery may hold up further supply chain processing by partners.

From cargo travelling across continents, to people moving within large work sites or remotely in areas where there is no terrestrial network, to parcel deliveries and wildlife roaming their habitat, asset tracking takes an ever-wider variety of forms. All of these are supported by IoT, both on the ground and – increasingly – from space.

In 2024, there continues to be a wide range of risks and challenges faced by businesses. For example:

Cargo thefts are on the rise, at best delaying shipments and at worst resulting in the total loss of goods. In Q1 of 2024 in the U.S.A. alone, CargoNet reported 925 cargo theft incidents, worth an estimated \$154.6 million.

Packages that are lost in transit result in loss of revenue and dissatisfaction from customers. The National Consumer League estimates that approximately 1.7 million packages are lost every quarter, costing the logistics industry \$50 billion annually.

Up to 20% of food is spoilt and 13% of pharmaceuticals lost globally during transportation - amounting to a huge amount of waste. In fact, McKinsey estimates that \$600 billion of food is wasted globally either during or after harvest, whilst KIWI Technology predicts that 950 million people could be fed with food currently lost to broken cold chains.

Increasing incidences of vehicle theft impact businesses and consumers alike leading to loss of revenue and higher insurance

premiums. According to Interpol, “In 2023, around 74,917 motor vehicles were identified as stolen.”

Livestock rustling continues to be a costly problem for farmers in many regions. Within South Africa alone, livestock theft cost farmers \$81 million in 2021, according to iSiTECH. Similarly, in Venezuela, around 700,000 cattle (7% of the total cattle population) are smuggled or rustled each year.

Inability to locate equipment in hospitals wastes man hours and hinders the care of patients. A Nursing Times survey found that more than one-third of nurses spent over an hour per shift trying to locate essential medical equipment – the equivalent of 40 hours per month.

Untracked workers in higher-risk jobs can result in unnecessary injuries or even loss of life. According to the Bureau of Labor Statistics, the construction industry recorded the third-highest rate of all recorded injuries and illnesses in the U.S. workplace, with nearly 20% of U.S. workplace deaths attributed to the construction industry.

The IoT market is also developing rapidly, with new technologies offering solutions that are cheaper, smaller and increasingly global in scope compared with just a few years ago. As a result, IoT now has a major part to play in assisting with these and many other challenges in the asset tracking market.

Our sponsors for this report are great examples of this. EchoStar Mobile has taken LoRaWAN® technology into space, combining the low cost and low power attributes of LoRaWAN® with Europe-wide satellite coverage for low-cost connectivity across borders. Up to now, satellite coverage has been several orders of magnitude higher cost than cellular. Not anymore.

Meanwhile, Sony Semiconductor has developed the world's first cellular IoT SoC to combine LTE-M/NB-IoT, unlicensed spectrum communications protocols, and satellite connectivity (NTN) in a single solution. Ideal for asset tracking applications utilising cellular networks.

In addition to being the inventor and supplier of LoRa® technology, Semtech also uses the Sony SoC in its new series of cellular modules. These offer ultra-low power consumption and innovation capabilities for modern asset tracking needs, reducing current consumption by up to 80% compared

to previous generation LPWA modules, effectively quadrupling the battery life of tracking devices.

Our final sponsor is Digital Matter, a leading global developer and supplier of GPS asset tracking, sensor monitoring, and advanced telematics solutions. The company's designs include both Semtech and Sony Semiconductor technologies. Engineered to exceed expectations, Digital Matter offers a versatile range of 'deploy once' hardware, with the largest portfolio of battery-powered IoT tracking devices across various connectivity and location technologies.

As such, our sponsors for this report are all complementary – operating in different parts of the asset tracking value chain and demonstrating the use of latest technologies in this area. This report, like the others in the 'Succeed with IoT' series, is a reference document for those responsible for IoT projects within their companies, as well as those who develop and supply those solutions. We hope you find it useful.



Robin Duke-Woolley, Founder and CEO. Beecham Research
www.beechamresearch.com

IoT Sector Activities

This section shows the breadth of the asset tracking market. A wide range of asset tracking use cases are explored, which are identified on the sector chart then described in more detail.

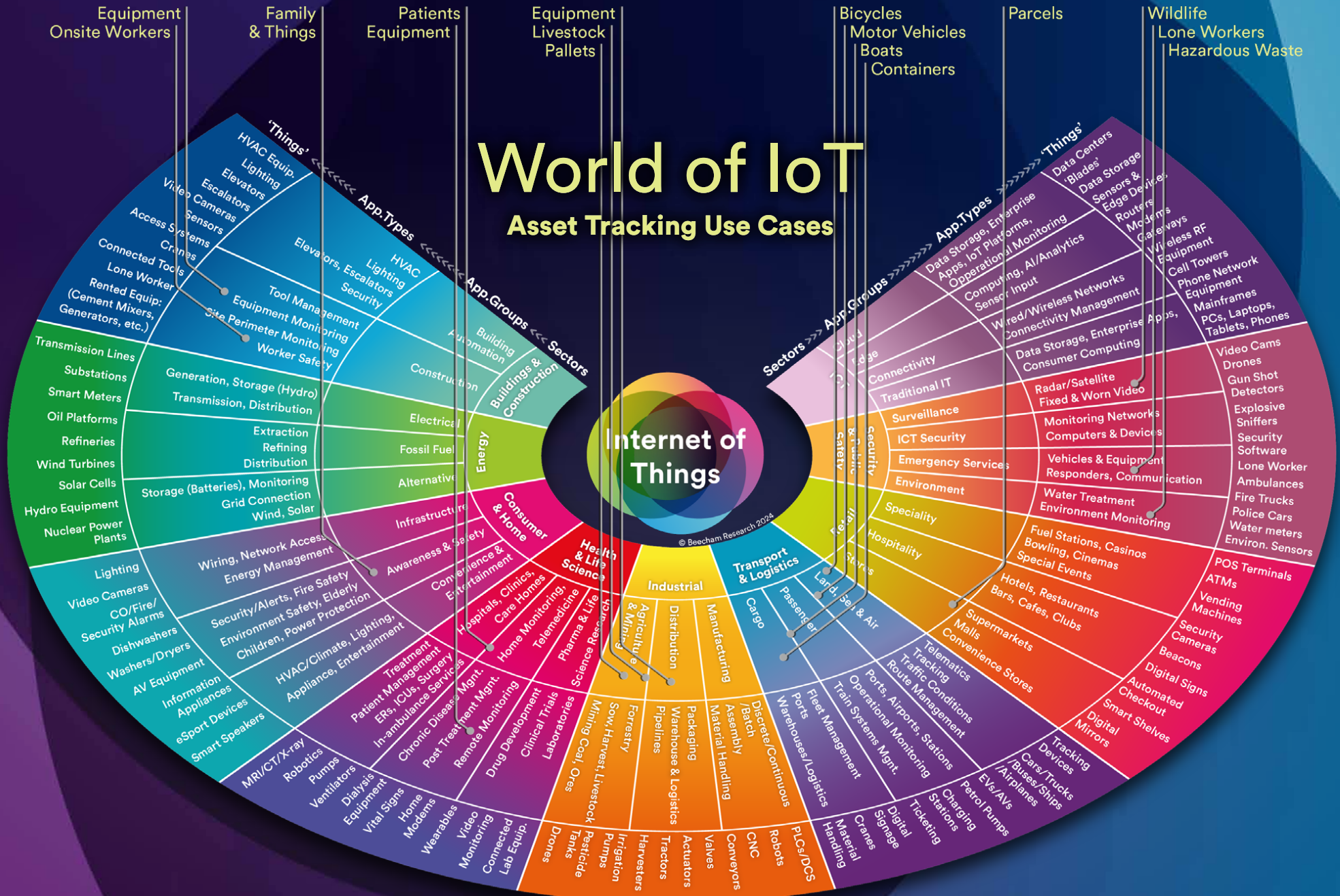
Sponsor case studies are also included. This is followed by a market and trends analysis of asset tracking.

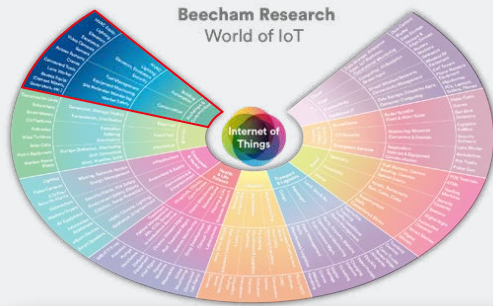
World of IoT

Asset Tracking Use Cases

Internet of Things

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Use Cases – Buildings & Construction

Equipment

French construction company deploys trackers on over 20,000 equipment units

Bouygues Construction Matériel manages a large fleet of construction equipment for projects across France. The challenge is ensuring the equipment is made available and distributed on time to the required site.

To enable GPS tracking of its inventory, intelligent sensors combined with multi-technology trackers were deployed on more than 20,000 pieces of equipment. The devices were designed to work outdoors as well as indoors, including the capacity to penetrate inside buildings and deep basements. This ensures the devices can transmit their location regardless of site conditions, enabling constant visibility of the equipment.

This allows the company to improve planning and resource allocation, reducing costs associated with external rentals and excess of resources. It also reduces the costs associated with lost equipment. In fact, through the adoption of this new data-based approach, the equipment division of the construction giant is projecting direct annual savings of 5 to 10% on maintenance and fleet management, and a ROI of 3 years.

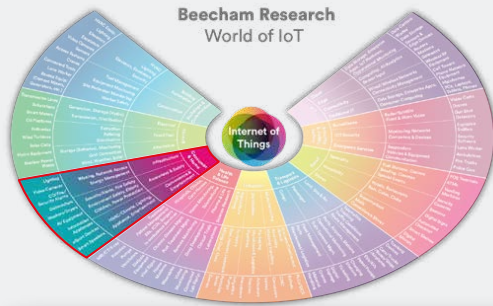
Onsite Workers

Tower construction project in Singapore employs tags to track workers

The Glory Tower construction project managed by Dragages Singapore spanned across 51 floors and formed the second largest tower construction site in the country. Beginning in 2019, the COVID-19 pandemic complicated the process, and created the requirement of tracking workers to ensure their safety whilst maintaining the continuity of work.

All workers were given small tags to attach to their person whilst onsite. These tags were robust and waterproof to withstand any bumps and any weather conditions on site. These tags then communicated with a mesh network (built on an infrastructure of router tags). Which then connected to the cloud via nine gateways – transforming data from the tags into GPS data. Only nine anchors were required per floor, thus enabling quick and easy installation.

The light infrastructure facilitated a quick and easy installation that enabled the company to track and locate its 1800 site workers within 10m of their position in real-time. This supported optimised organisation of the work teams and allowed identification of potential COVID-19 contamination areas to limit the spread of the virus. It also facilitated the collection of data to improve cost and implementation projections for future projects.



Use Cases – Consumer

Family & Things

Smartphones, wearables and item tags support growth of consumer tracking market

Tracking family and friends has become increasingly convenient thanks to the prevalence of smart phones and the growing versatility of wearable technology. ABI Research predicts that the global installed base of consumer tracking devices will reach 68 million by 2026, whilst a 2024 survey by SafeHome suggests that 170 million Americans own at least one personal location-tracking device that isn't a smartphone.

The same survey indicates that (other than smartphones) smart watches are the most popular personal location-tracking devices, owned by 29% of Americans. Although devices specifically designed for child tracking are uncommon, many parents use location apps on their children's phone to monitor their movements and ensure their safety. Adults may also use location sharing apps to ensure their safety when taking a taxi or engaging in running or hiking activities.

Item locator tags are also popular amongst consumers, as they facilitate keeping track of important possessions such as wallets or keys. They may also be used to locate other items like luggage, sports equipment or tools. However, these are typically BLE devices and work most precisely within the home.





Case Study – Powering personal tracking across Europe



With adventure sports on the up, more individuals are taking up activities such as hiking, trail running, cycling, skiing, rock climbing or caving, kite-surfing, all of which come with some risk. Such activities tend to take place in more remote areas where terrestrial networks may be limited or unavailable.

Thanks to the ubiquitous European coverage provided by EchoStar 21, individuals can use personal trackers while taking part in adventure sports so that their location can be identified by friends, families and, in case of emergencies, search and rescue teams.

APIK

The French outdoor geo-safety manufacturer APIK uses LoRaWAN® and EchoStar connectivity to connect its personal tracking products. APIK has been recently acquired by Abeeway, the geolocation subsidiary of Actility.

How search and rescue works with KIP Beacon and Findr

Search and Rescue comprised of two devices:

1. KIP Beacon – a small ‘card’ format device carried by hikers/skiers/other individuals roaming in remote locations. Uses LoRaWAN satellite network for GPS location and connects with the KIP mobile app where the location and journey can be viewed.

2. Findr – a tiny (91g) device used by rescue teams, enabling them to identify any KIP beacon located up to 12km away with a 30cm precision. Through LoRa® peer-to-peer technology, it doesn’t require a network to function. The device is qualified to be carried in helicopter as well allowing to scan up to 6,000Km/hour.

If the carrier runs into trouble, they can press a button to send a distress alert. Similarly, if someone viewing the journey on the app notices an unexplained lack of movement, they can contact the rescue services.

Since each KIP beacon has its own unique ID, the rescue services can search for the device, locate it and provide swift aid to the Beacon carrier where needed, potentially saving lives.

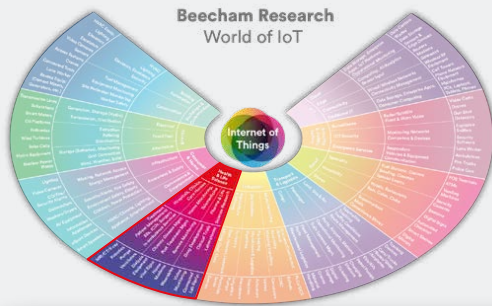
The APIK devices do not rely just on GNSS, but also emit a powerful signal that allows them to be located independently of any network or external geolocation system. In the case of mountain rescue, this works even for avalanche victims.

Relay capability

Beacons can act like relays and work together to send location data, messages and distress alerts. For instance, if there is a beacon in a container that has no access to satellite networks, it can communicate with another beacon, which can then communicate via the satellite network.

The ability for these devices to act as relays means that no infrastructure is required. As such, operations are highly scalable and easily deployable.





Use Cases – Healthcare

Patients

Patient location tracking supports dementia care in Italian memory care facility

The opening of a new care facility in Bolzano in 2020 by Italian rehabilitation provider Reha Klinik provided the opportunity to create a highly digitalised site. With a focus on caring for dementia patients, location tracking and easy communication amongst staff is essential.

Each patient at the facility wears a bracelet encoded with a unique ID and location sensors. Compatibility with Wi-Fi facilitates a site-wide connection, whilst BLE connectivity guarantees location identification to within 1m. As such, the centre maintains full visibility over the patients' movements, enabling staff to quickly find individuals in case of a medical alert. These alerts can be generated by the patient by pushing a button on the bracelet or automatically sent if the accelerometer in the bracelet detects a fall or long-term lack of movement. In addition, the centre can set customised alerts for individual patients based on their medical status or expected activities at certain times of day.

The interoperability of this solution with existing care software ensures scalability of operations for future patients. The provider is also considering expanding the project to capture data on the patients' vital signs. This would allow the facility to monitor their overall health as well as their location and movement.

Equipment

IoT mesh networking solution enables UMC staff to locate medical devices quickly

With over 1,100 beds and more than 11,000 employees, University Medical Centre (UMC) Utrecht is one of The Netherlands' largest healthcare facilities. Like many medical institutions, it remains under pressure to improve organisational efficiencies whilst maintaining patient care and preserving costs. Given the size of the establishment and the fact that medical devices are frequently moved from one room to another, the time spent searching for required equipment significantly contributes to these operational inefficiencies.

To solve this problem, they attached tags to all moveable medical devices. A mesh network was also implemented with anchors placed at strategic positions to maximise visibility. Signals from these anchors are then used to accurately calculate the position of the tags and therefore the devices.

This enables staff to determine the location of medical equipment at all times. As such, healthcare workers no longer waste valuable time locating the right equipment and can instead focus their time on better caring for their patients. In addition, the network is easy-to-install and easily extendable, thus putting no limit on the site it can cover or the number of devices that can be tracked.



Case Study – ‘Heart of the Nation’ External Defibrillator



The Challenge

Heart of the Nation is a non-profit charity which is leveraging IoT asset tracking technology to enhance Automated External Defibrillator (AEDs) accessibility across Australia. It partnered with Inauro to build a comprehensive database of defibrillators across the country.

Some 30,000 Australians experience cardiac arrest each year. With 300 accessible connected AEDs already deployed and a database of over 7000 currently available, their partners have significantly increased awareness about cardiac arrest and the importance of the Chain of Survival. The Charity’s vision is to enable access to AEDs within one minute of all locations across Australia.

“The tracking and management of AEDs via the IoT is a huge step forward for making AEDs publicly accessible.”

The Solution

Leveraging Digital Matter’s battery-powered GPS tracking devices and Inauro’s IoT platform, Perspio™, AED locations are displayed in real-time in the Heart of the Nation Mobile App and Web Platform.

Since AED’s are susceptible to theft, owners often store them in secure locations, which can hinder public accessibility when needed. To overcome this,

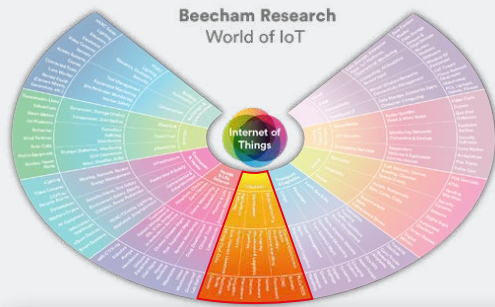
Heart of the Nation actively encourages local councils and community clubs to ensure the security of their AEDs while still making them easily accessible. The Perspio platform offers Recovery Mode, allowing for near real-time GPS tracking to locate stolen or misplaced equipment.

In addition to ensuring that the machines are in working order at all times, Inauro’s custom-built platform allows for battery data to be extracted separately from the device’s location and notify owners of any maintenance required on the AED machines.

The Benefits

The collaboration between Heart of the Nation, Inauro, and Digital Matter has significantly improved public health and emergency response in Australia. Making the defibrillator database readily accessible to the public has the potential to save numerous lives.

Says Greg Page, CEO and Founder of Heart of the Nation, “The tracking and management of AEDs via the IoT is a huge step forward for making AEDs publicly accessible and helping to ensure they are always rescue-ready.”



Use Cases – Industrial

Equipment

Real-time forklift tracking improves operations in Portuguese water heater plant

Bosch Termotechnologia is a leading manufacturer of water heaters based in Portugal. With the main production building alone covering 10,000 square metres, it uses a large number of forklifts and vehicles (both manual and automatic) to transport components and materials to the necessary point in the production line. Given the size and scale of operations, the plant faces internal logistics challenges, with staff struggling to understand shop floor activities.

To combat this, the company implemented a real-time location system (RTLS) to track the forklifts within the plant. UWB was chosen as the connectivity technology thanks to its easy configuration and broad frequency spectrum. Given the high metal density of certain areas of the plant, UWS also offered flexibility of deployment, with antennas placed strategically to achieve optimal connectivity. All data collected is retained within Bosh's private network to maintain control of sensitive data.

This system enables the tracking of several forklifts simultaneously to a granularity of better than 50cm. As such, the logistics team has much improved visibility of plant operations, facilitating faster planning, improved vehicle routing and the ability to adapt to production changes in real time.

Livestock

Nambian farmers use GPS trackers to protect calves and improve breeding management

Nambian farms can span up to 20,000 hectares of land and are typically in highly rural locations with poor or no cellular connectivity. Attacks on livestock by leopards and other predatory animals incur major losses to the farmers' livestock population and pose a major threat to profitability. As such, a pilot cattle tracking project was instigated to help protect the livestock.

Given the lack of cellular coverage in the area, a private LoRaWAN® network was deployed. A compatible GPS tracking device was then attached to each cow to





Case Study – Seamlessly monitoring mobile assets



The Problem

Companies from different industries are looking at the Return on Investment (RoI) that IoT can bring to their operations, particularly massive IoT where small amounts of data are sent from hundreds or thousands of connected devices. Utilities, railways, transportation, logistics, agriculture, oil & gas and the maritime sector can all benefit from IoT.

Any company involved with either the transportation or distribution of goods or managing assets in the field faces operational constraints that are often improved by IoT solutions to track the location, condition and status of those goods and assets.

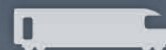
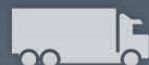
The Challenge

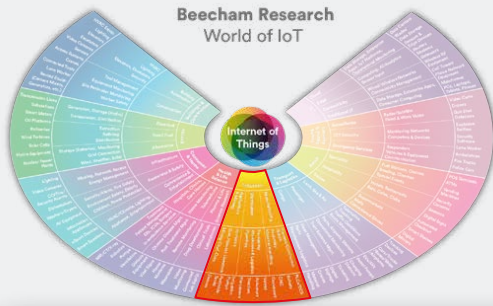
IoT can help to improve the operational efficiency of these companies; however, between and even within countries, IoT networks can experience gaps. This is true even in well-connected urban and semi-urban areas.

In the majority of cases, if one wants to monitor an asset which is moving from port to location, one needs to rely on using multiple networks, often involving complex roaming agreements and still be willing to tolerate gaps in coverage, which can result in large holes in data and blind spots in operations.

The Solution

The EchoStar Mobile LoRaWAN®-enabled network makes seamless coverage across the whole of Europe possible, providing a single network with no roaming required and zero service gaps. This means that an asset can be monitored and tracked seamlessly and effectively. Additionally, its dual-mode operations (satellite and terrestrial) mean that on arrival at a logistics hub that may already have a terrestrial network provisioned, the asset can easily transition to that network for continued monitoring on site.





Use Cases – Industrial

enable farm-wide location tracking. Ear tags were used for adult cattle whilst spike collars were used for calves. The latter acted as a deterrent to leopards whilst also providing alerts in the case of injury, enabling swift identification and location of the attack.

In the first 15 months of implementation, only one leopard attack incident occurred and without fatality, marking a significant reduction from the frequent losses of previous years. In addition, the GPS ear tags were used for tracking bull movement and improve breeding management. Furthermore, the established network has been expanded to enable the farm to implement other smart farming initiatives.

Pallet Boxes/Crates

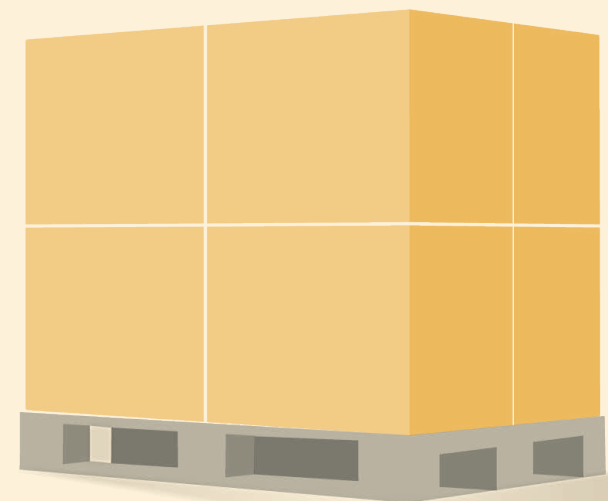
Pallet track-and-trace project expanded to minimise asset losses

Primarily serving the fast-moving consumer goods, retail and general manufacturing industries, Brambles owns the largest rental pool of reusable pallets and containers, mostly through its CHEP brand. Historically, the business expected to lose 10% of its assets yearly, with only 2% attributed to pallets reaching the end of their lifecycle. This would cost CHEP around USD360 million per year (6.5% of its yearly revenue) to replace them.

To combat these losses, Brambles instigated a track-and-trace project in 2021. Involving eleven retailers and wholesalers across Spain, France, Italy and

Portugal, a series of CHEP pallets were equipped with CE/EC certified tracking technology. This gave the company greater visibility and insight, facilitating the identification of inefficiencies and causes of pallet loss.

Thanks to the success of the initial project, Brambles started expanding its pallet track-and-trace system across several Central and Eastern Europe countries in 2023. The practice of tracking pallets will become increasingly vital to the company as the more expensive and longer-lifespan plastic pallets become more prevalent in the market.





Case Study – Jet Engine Parts Tracking



The Challenge

The 2020 pandemic forced a large manufacturer of aircraft parts to leave critical assets unattended in an uncontrolled environment. The assets became unusable, resulting in a substantial financial loss for the company.

To improve visibility in its supply chain, the manufacturer selected Digital Matter's Oyster Edge battery-powered Indoor/Outdoor GPS asset tracking and Bluetooth Gateway to monitor the location and condition of its critical aircraft assets as they moved globally through production, storage and delivery.

The Solution

Digital Matter's Oyster Edge device is installed on the asset's transportation stands, enabling complete visibility as the asset moves between indoor and outdoor environments. The device supports GNSS and Wi-Fi positioning technologies as well as Advanced Cellular Tower Location.

Other features include:

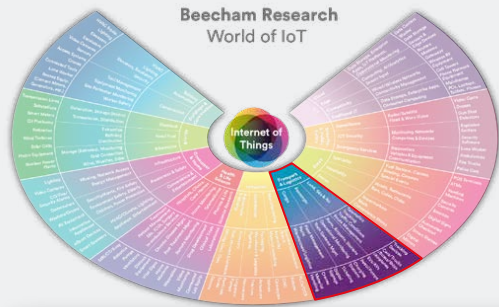
- Supporting 10+ years of battery life, reducing operating costs by minimizing physical device management.
- Transferring the location processing workload traditionally handled on the device to the Cloud for power savings.

- Connecting to global low-power Cellular IoT Networks (LTE-M (Cat-M1) / NB-IoT) and supporting cross-network and cross-carrier roaming; affording complete visibility as the assets move regionally and nationally.
- The Oyster Edge also functions as a Bluetooth Gateway to any third-party Bluetooth accessory.
- The Oyster Edge also supports impact (high G-Force) monitoring with alerts, allowing the manufacturer to identify where assets are experiencing rough conditions.
- The Oyster Edge is programmed, updated and debugged over the air, allowing the manufacturer to take full control of device functionalities remotely and at scale. Finally, device data is securely integrated with an asset management platform where location data, reporting, and alerts are managed.

The Benefits

By providing visibility of critical high-value assets in transit, the Oyster Edge allows the manufacturer to authenticate their location at any time, track speed of movement, arrival times, and monitor storage conditions. Oyster Edge also enables a competitive advantage with sustainability as there is less 'waste'.

“Providing visibility of critical high-value assets in transit.”



Use Cases – Transport & Logistics

Bicycles

Bicycle trackers deployed to identify theft patterns in the Netherlands

In the Netherlands, theft of bicycles is highly lucrative with the stolen bike market holding a value of around EUR600 million. In fact, in Amsterdam alone, it is estimated that 80,000 bicycles are stolen per year.

AMS Institute, TU Delft, and MIT Senseable City Lab, in partnership with the Municipality of Amsterdam, teamed up to study and identify patterns in bike theft. To initiate the project, 100 bikes were equipped with GPS trackers and left chained in common theft areas of Amsterdam. Within 5 months, 70 bikes were stolen. They continued to be tracked, with the start and end of each trip logged. This identified the top 20 areas in the city for theft location as well as the days and time thefts most commonly occurred. It was also found that these bikes typically resumed regular use, often in the same areas from which they were stolen, with 50 of the 70 frequently visiting the city centre. In fact, 30% of the stolen bikes could be attributed to organised crime.

Although this study did not involve the recovery of bikes, the same technology could be used by consumers and local law enforcement to help retrieve lost or stolen bikes. The findings are also expected to be used with the design of police and theft recovery practices worldwide.

Motor Vehicles

Telematics provide real-time visibility for Scottish truck fleet

Operating a fleet of trucks across the UK and Europe, Glasgow-based John Hardie Transport (JHT) is a provider of bespoke freight transportation services. To ensure punctual deliveries and gain greater control of operations, the company sought to deploy a tracking system.

As such, a GPS telematics solution was deployed. With each truck transmitting location data to a management platform every 30 seconds, the company now has near-real-time visibility of its fleet at all times. Combining this with live traffic alerts enables the management team to amend routes so that the trucks can avoid congestion and remain on-schedule. The system also generates insights to do with driver speeds, acceleration, braking and idling which can be used to improve driver behaviour for safety and cost control.

In addition, integration of the tracking system with fuel cards facilitates the monitoring of financial transactions. This improves financial security, digitalises the process of expense claims and provides the company with valuable information about fuel costs.





Case Study – Rally Vehicle Tracking and Monitoring with Semtech's AirVantage® Smart Connectivity



One of our European clients specializes in solutions for tracking individuals and assets. A notable application involved monitoring vehicles during cross-country rally races, where competitors navigate through urban areas, rural landscapes, and even deserts. To ensure the safety of rally participants, the solution provider implemented a communication system that enables drivers to request assistance via a connected device installed in each vehicle. For this mission-critical application, where people's lives are at stake, our client aimed to leverage as many operator networks as possible to maximize the network coverage and use the satellite services as failover connection only to keep costs down. Ideally,

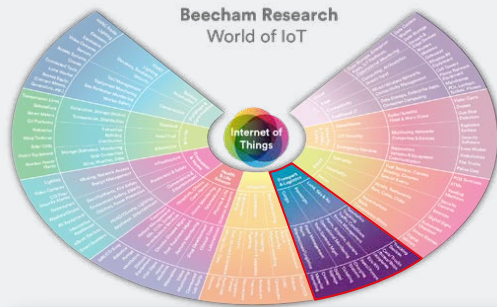
they wanted a single global SIM that could access at least two operator networks and autonomously recover from network disconnections without human intervention.

“For this mission-critical application, where people's lives are at stake, our client aimed to leverage as many operator networks as possible.”

Our client selected Semtech's AirVantage Smart Connectivity, which boasts multiple IMSIs and a built-in intelligent SIM applet, enabling seamless connection of the vehicle to high-quality mobile networks through over 600 partner networks spanning more than 190 countries and territories. This Smart Connectivity solution provides one SIM for global access, along with a dedicated support team available 24/7/365 to ensure optimal connectivity during critical sporting events.

Thousands of vehicles were connected through Semtech's Smart Connectivity, enabling distressed drivers to communicate with rally organizers and receive prompt assistance. Our client successfully replicated this communication solution for various rally courses and other sporting events.





Use Cases – Transport & Logistics

Boats

Korean vessel monitoring system combats illegal fishing activities

Illegal, unreported and unregulated (IUU) fishing is a major problem that impacts sustainability and fish populations worldwide. In 2013, the US and EU identified Korean fishing ships as engaging in this activity, damaging the country's reputation and negatively impacting its exports.

To properly monitor and control its fishing practices, the Korean government distributed a Vessel Monitoring System to all fishing vessels. This system communicates with a monitoring platform via satellite connectivity, typically sending location updates every hour. Where necessary, the frequency of the updates can be reduced to every minute to facilitate more targeted monitoring. In addition, it can be programmed to generate automatic alerts for suspicious behaviour.

This provides the Korean government with better vision and control over its fishing vessels, as well as improving the safety of fishermen. The tracking system also facilitates an electronic reporting, enabling stock assessment and analysis for improved and transparent operations. As a result of these changes, Korea is no longer on the preliminary IUU country list, thereby improving its reputation in distant water fishing.

Containers/Cargo

Smart containers provide security for Bolivian mineral transportation company

Bolivian-based Penfold Ltda. is a transportation company specialising in solutions for the import, storage and distribution of raw minerals and metals. Many of the materials they transport are valuable and sought after by thieves and smugglers.

To mitigate security risks, the company invested in a smart container solution. All containers come with a unique ID number and are equipped with GPS sensors to provide constant location visibility. They are also equipped with motion detectors to capture the opening and closing of container doors and to send an alert in the case of an intrusion. The containers continuously collect and transmit data enabling the company to control and manage their shipments in real-time.

One year on from the tracking solution implementation, incidents relating to theft and smuggling were reported to be greatly reduced. Further benefits included enhanced operational efficiency, the ability to provide updates to customers and the reduced need for related security services, thus providing significant cost savings.





Case Study – Global Container Tracking with HL7812 LPWA Modules



An industry-leading provider of container tracking solutions enhanced their global operations with the adoption of HL7812 LPWA modules, ensuring seamless and efficient tracking across diverse transportation modes.

The company offers real-time tracking solutions for a wide range of containers, including reefer, maritime, rail, and road containers. They leverage Semtech LPWA cellular modules to connect tracking solutions interfacing with all major container models. Their service not only tracks the position of containers but also monitors critical sensors such as door openings, shocks, humidity, and temperature, providing actionable

insights throughout the supply chain. This ensures robust quality control and regulatory compliance, allowing clients to identify and address issues like excessive moisture exposure or deviations from predefined routes promptly.

The choice of the HL7812 LPWA module rested on its ultra-low power consumption, extensive global coverage, and Semtech's reputable experience in low-power deployments.

With ultra-low power consumption, the HL7812 module offers exceptional battery life, promising to enable up to 10+ years of operation for the tracking system. It supports LTE-M and NB-IoT networks worldwide and also 2G fallback when LPWA networks become unavailable, providing an optimal balance between energy efficiency and extended coverage. Looking ahead, the company valued the HL7812's future capability to support non-terrestrial networks (NTN) via a firmware upgrade. This will enable tracking of containers even in the most remote areas, further enhancing the reliability and breadth of their tracking solutions.

Given the sensitivity and regulatory nature of some transported goods, the company sought a trusted supplier, complying with stringent privacy and data security regulations. Semtech was selected for its proven track record in reliable, low-power deployments.

“Their service not only tracks the position of containers but also monitors critical sensors.”





Case Study – Revolutionizing Returnable Asset Management: Konvoy and Sony’s Altair ALT1250 Chipset

SONY

Low value returnable assets such as bulk containers, bins, crates and kegs, face significant challenges across their extended useful life. These include complex supply chains, lost assets and often condition-sensitive products. These issues result in substantial financial losses and operational inefficiencies, and current tracking technologies are uneconomic or too battery intensive to solve them.

Recognizing these challenges, Konvoy has developed an innovative solution for returnable assets and deployed it at scale to IoT-enabled ‘smart’ kegs, providing real-time visibility and actionable insights through their Katch tracking device and Konvoy Cloud Platform.

To power their smart keg solution, Konvoy has integrated Sony’s Altair ALT1250 chipset for cellular connectivity. The ALT1250 chipset offers multi-band capability for NB-IoT and LTE-M connectivity, oneSKU technology for global operation, and a powerful, proven cellular modem. These features make it an ideal choice for Konvoy’s Katch device to provide reliable, cost effective and global coverage.

Konvoy’s Katch device, equipped with the ALT1250 chipset, provides real-time tracking and monitoring capabilities to kegs. Once Katch is deployed to a keg, it connects to the Konvoy Cloud platform, utilizing the ALT1250’s low power and LTE-M/NB-IoT global roaming capabilities to make location data available throughout the keg’s journey, around the globe, until it reaches its destination.

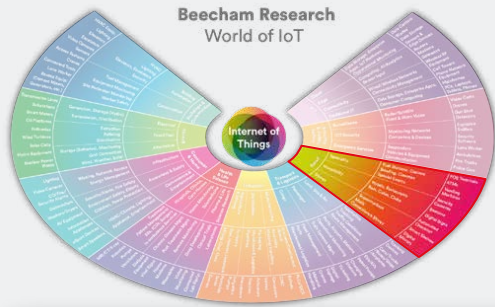
The ALT1250 chipset offers several key advantages that Konvoy particularly appreciates:

1. Low peak power demand, reducing stress on the battery and extending the operational life of the Katch tracking device by up to 10+ years which is important given the general life of a keg is 30 years.
2. Optimized mobile country frequency scan, which reduces the number of bands to scan, offering significant energy savings. This feature is especially useful as Konvoy’s devices are configured to all supported LTE bands by default, improving efficiency and reducing power consumption.
3. Smaller footprint, helping to reduce overall PCB size and allowing for more compact and streamlined attachment to assets of all shapes and sizes.

Konvoy’s Katch device is not limited to tracking location. It incorporates various sensors to monitor conditions such as temperature, motion and tilt. This comprehensive data collection enables Konvoy Cloud to provide a powerful tool for making critical logistics and cost decisions with real-time location check-in, temperature and event of interest monitoring.

By leveraging Sony’s Altair ALT1250 chipset, Konvoy has created a versatile IoT solution that addresses the unique challenges of returnable asset fleet management. The result is improved supply chain visibility, reduced asset loss, and enhanced product quality control throughout the distribution process. This innovative approach demonstrates how cutting-edge IoT technology can revolutionize traditional industries, offering a model for future advancements in supply chain management and asset tracking.

Altair



Use Cases – Retail

Parcels

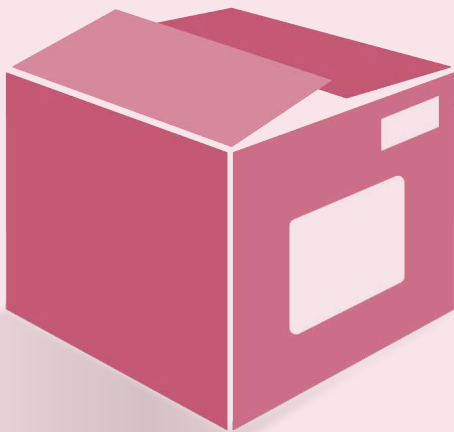
German mail-delivery company uses IoT to measure and improve efficiency of service

Postcon is the second largest postal carrier in Germany. Owing to 10 mail-sortation centres and employing 1,200 mail carriers in the Rhineland and Ruhr areas, the company is responsible for delivering over a billion letters and small packages each year. Operation efficiency is therefore a huge challenge.

Around 2000 active GSM cellular and Wi-Fi based trackers were therefore deployed, with around 500 typically in transit at any one time. The trackers are credit-card sized, lightweight and fit easily into standard mail envelopes.

They are then sent like a normal letter through the postal service, with carriers largely unable to identify them. The trackers are programmed to transmit their location every 15 minutes, providing the management teams with regular movement updates.

This enables the company to detect any bottlenecks or mistakes in the system, as well as better understand the circumstances leading to delays. The company also intends to develop the system to send alerts when an incorrect route is detected.





Case Study – Critical Shipment Asset Tracking with Semtech’s LoRa Edge ICs



An industry leading provider of supply chain asset management solutions uses LoRa Edge ICs for a new class of connected label devices that track real-time location and sensor data for critical shipments worldwide.

OnAsset Intelligence is a leading provider of supply chain asset management solutions to wirelessly locate, track, connect, and manage fixed and mobile assets. Their solutions enable real-time tracking of goods moving through the supply chain via air, road, rail, and ocean, whether in transit or storage. One key challenge lies in providing temperature monitoring and location tracking to life sciences, one of the most highly regulated industries globally. With a steadily growing number of

pharmaceutical products requiring precision environmental monitoring and location tracking, OnAsset’s support model embraces all wireless technologies, ranging from cellular, satellite, Wi-Fi, Zigbee, Bluetooth, GPS, and LoRaWAN.

Their latest innovation, Sentinel Flex Tag, is based on Semtech’s LoRa radio technology.

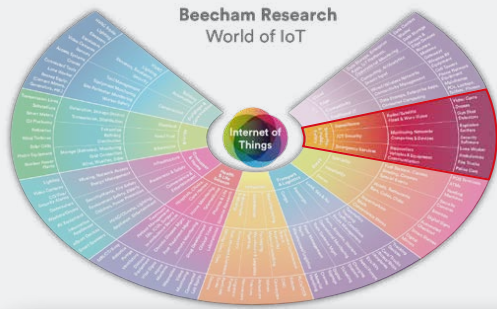
Adam Crossno, CEO of OnAsset Intelligence calls it “a game changing, new class of connected label device that provides real-time location and sensor information for critical shipments worldwide.”

OnAsset chose Semtech’s LoRa Edge ICs to meet their tough product requirements: extremely thin, low cost, capable of monitoring location, temperature, and shock, flexible enough to be attached to nearly any type of shipment, robust performance for consistent radio communications in the most challenging conditions, and long battery life.

“The result is not only a revolutionary product with a form factor and feature set to enable broad applicability across many use cases, but also the world’s smallest carbon footprint real-time tracking device. For future, we’re also evaluating other capabilities of the LoRa Edge platform, such as BLE beaconing and round-trip-time-of flight, for added virtual geofencing security of high-value goods transported globally,” added Crossno.

“The result is not only a revolutionary product but also the world’s smallest carbon footprint real-time tracking device.”





Use Cases – Security & Public Safety

Wildlife

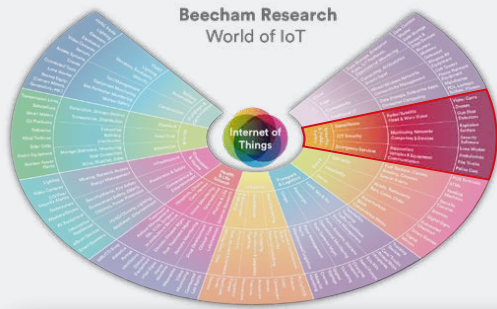
Rhinoceros IoT trackers used by wildlife non-profit to prevent poaching

Volunteering Africa is a non-profit wildlife preservation organisation founded in South Africa, with a major focus on rhinoceros protection. Poaching is a big challenge for the organisation since with over 7,000 of these animals killed in the last ten years for their horns. With only around 27,000 rhinos left worldwide, they must be protected to preserve their species.

In the form of a collar or bracelet, tracking devices are attached to a rhino's ankle. The trackers are designed to be resilient to the animals' environment, as well as long lasting to minimise the frequency of replacement. Data is transmitted via a private LoRAWAN network to a cloud platform where it can be viewed and assessed. The devices can also be configured remotely to enable geofencing or anti-theft applications as well as alerts when animals are entering or leaving a specific area.

This solution enables seamless real-time location tracking of individual rhinos and enables rangers to be prepared much faster in the case of poaching incidents. It has proven to reduce the number of poached rhinos and will be extended to other wildlife parks and to other endangered animals. In addition, the established private network enables other smart applications such as the monitoring of park fences or gates and smart water usage.





Use Cases – Security & Public Safety

Lone Worker

ID badge style trackers ensure safety of lone workers in remote locations

Edina is a leading supplier, installer and maintenance provider for combined heat and power (CHP) solutions with offices across the UK, Ireland and Australia. The company manages over 200 staff members, with many of these being lone technical support engineers. With public and private clients across the agricultural, industrial, food processing and wastewater treatment sectors, these engineers often perform their work in remote areas.

As such, all engineers are required to wear an ID badge-style device to track their location. Equipped with Wi-Fi calling capabilities and a roaming SIM card, the device ensures wide network coverage, helping them stay connected. It is also dust and waterproof and includes an automatic incapacitation alarm in the case of a fall or other health issue.

The device connects to an online management system where managers can monitor the location of the engineers, receive and react to 'Man Down' alerts, share job information and demonstrate job completion to customers. As such, it provides significant operational benefits alongside the primary purpose of safety.

Waste Management

Ultra-rugged trackers facilitate monitoring of construction waste

An important part of construction projects is managing demolition waste. Any waste that is deemed contaminated or unfit for re-use is defined as spoil; discarding this incorrectly or without creating proper records carries large financial penalties. Australian construction company John Holland runs projects that typically generate tens of thousands of metric tonnes of spoil, making the tracking and audit of disposal a vital part of business operations.

To facilitate this, the company deployed ultra-rugged, robust and easy-to-install tracking devices. Equipped with a gyroscope, these devices can detect the truck loading and unloading actions as well as location. In addition, device communications via LTE-M and NB-IoT ensure a long battery life and cost-efficient performance.

This system enables the company to accurately retain records of all spoil disposal, ensuring they meet regulatory requirements. It also provides the opportunity to analyse spoil movement data which can then be used to improve operations and sustainability.



Case Study – Skip Bin Tracking in Finland



The Challenge

Delete Group operates over 600 waste and communal skip bins and containers throughout Finland. They use the Yabby Edge Indoor/Outdoor battery-powered asset tracking device to optimise their waste management operations, With support from Digital Matter channel partners, Prisma Quality.

The Solution

The Yabby Edge device supports over 10 years of battery life; it offers both outdoor and indoor location tracking and operates on global LTE-M/NB-IoT networks. Compact and IP68-rated ultra-rugged, it is installed

on the front of Delete's range of skip bins near the lifting mechanism to ensure the device can reliably scan for GNSS while outdoors. If a GNSS fix cannot be obtained, the Yabby Edge automatically switches to Wi-Fi scanning and/or Cell Tower Location to determine location.

Cloud-based location solving is a power-saving technique that transfers the location processing workload - traditionally handled on-device - to the

Cloud. This reduces OPEX costs by eliminating frequent and expensive battery changes or manual recharge cycles.

Delete Group also needed to upgrade their existing asset tracking hardware to the latest low-power LTE-M/NB-IoT connectivity. Seamless roaming between the two Cellular IoT networks was also necessary, as Delete's bins move between the two networks regularly.

The Benefits

With Over the Air updates, reporting frequency and other tracking parameters, Delete's Yabby Edges can be quickly configured remotely to best fit any bin tracking application. Currently set to report twice daily regardless of movement, they will perform reliably for an estimated 10 years before requiring a battery change.

"Says Petter Kroneld, Co-founder at Prisma Quality, "Maintaining a bird's eye view of where, how many, and how long bins are deployed across worksites is critical in optimising and improving the utilisation of these most important assets and reducing downtime."

“Maintaining a bird's eye view of where, how many, and how long bins are deployed across worksites is critical.”

Global Asset Tracking Market

Asset tracking is proving to be an increasingly crucial part of business across industries – ensuring the safety and security of assets as well as generating data that can be used to assess operations and inform business decisions.

From cargo travelling across continents, to people moving within large work sites, to wildlife roaming their habitat, asset tracking takes a wide variety of forms – all of which can be supported by IoT.

In 2024, there continue to be many risks and challenges faced by businesses.

For example:

- Cargo thefts are on the rise, at best delaying shipments and at worst resulting in the total loss of goods. In Q1 of 2024 in the U.S.A. alone, CargoNet reported 925 cargo theft incidents, worth an estimated USD154.6 million.
- Packages that are lost in transit result in loss of revenue and dissatisfaction from customers. The National Consumer League estimates that approximately 1.7 million packages are lost every quarter, costing the logistics industry USD50 billion annually.
- Up to 20% of food is spoilt and 13% of pharmaceuticals lost globally during transportation - amounting to a huge amount of waste. In fact, McKinsey estimates that \$600 billion of food is wasted globally either during or after harvest, whilst KIWI Technology predicts that 950 million people could be fed with food currently lost to broken cold chains.
- Increasing incidences of vehicle theft impact businesses and consumers alike leading to loss of revenue and higher insurance premiums. According to Interpol, “In 2023, around 74,917 motor vehicles were identified as stolen.”
- Livestock rustling continues to be a costly problem for farmers in many regions. Within South Africa alone, livestock theft cost farmers \$81 million in 2021, according to iSiTECH. Similarly, in Venezuela, around 700,000 cattle (7% of the total cattle population) are smuggled or rustled each year.
- Inability to locate equipment in hospitals wastes man hours and hinders the care of patients. A Nursing Times survey found that more than one-third of nurses spent over an hour per shift trying to locate essential medical equipment – the equivalent of 40 hours per month.
- Untracked workers in higher-risk jobs can result in unnecessary injuries or even loss of life. According to the Bureau of Labor Statistics, the construction industry recorded the third-highest rate of all recorded injuries and illnesses in the U.S. workplace, with nearly 20% of U.S. workplace deaths attributed to the construction industry.

Trends and Challenges

Increasing need for visibility across sectors

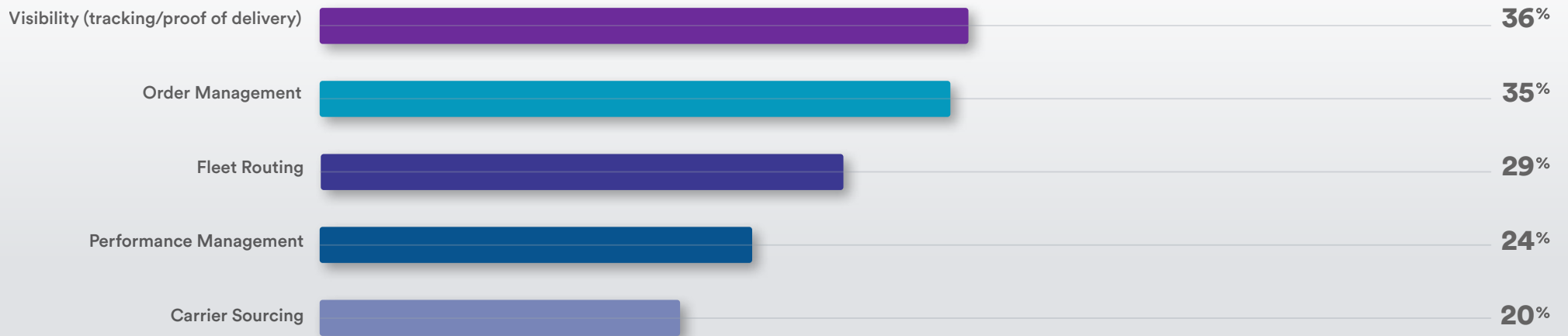
Increasing digitalisation across sectors is paving the way for greater deployment of IoT tracking devices. This provides visibility over resources which in turn enables businesses to:

- Combat theft and reduce losses.
- Assess fleet operations and improve efficiency.
- Locate equipment or goods faster, saving time and man hours.
- Create a track-and-trace log for auditory requirements.

The expanding variety of connectivity options is also enabling businesses to tailor a solution to their specific needs. For instance, lower-latency and data efficient options facilitate the tracking of assets in real-time, ensuring 24/7 visibility.

In fact, in Descartes' 2024 Annual Global Transportation Management Benchmark Survey, visibility (tracking/proof of delivery) was recorded as the most in-demand technology investment for the seventh year running, with 36% of the 630+ respondents choosing this as a priority, as shown in **Figure 2.1**.

Figure 2.1 Expected greatest transportation IT investments within the next two years



Source: Descartes

Growing range of asset tracking devices supports new applications

The capabilities of IoT devices continue to advance rapidly: there are now more asset tracking devices than ever before in a greater variety of formats. For example, label or sticker formats are slim, unobtrusive and easily adhere to smaller individual assets. Consumer wearables are also becoming smaller, more stylish and more convenient to wear, improving use in everyday life.

However, it's not just about size: ruggedised and weatherproof devices support tracking applications in harsher environments. Meanwhile, connectivity agnostic devices are versatile, enable scalability of operations and are future-proof to provider switches or generation upgrades.

In terms of connectivity, the ability to connect using LPWAN technologies (such as NB-IoT or LoRa) gives devices a long-lifecycle, reducing maintenance costs and providing a more cost-efficient option for low-data transfer needs. Alternatively, 5G services offer fast, real-time data collection.

Tracking-as-a-Service growth combats initial high costs

As the asset tracking industry continues to develop, so does Tracking-as-a-Service (TaaS). In 2023, market estimates ranged around USD 5.2 billion with growth of around 17% CAGR in the period 2023-2030.

Growth of the TaaS industry is driven by businesses without in-house expertise seeking a cost-effective and quick-to-deploy solution for their asset tracking needs.

Although the market is currently dominated by large enterprises (holding around 65% of the market share), the SME segment is anticipated to see the fastest growth in the coming years.

Technavio cites innovation, regulatory compliance and service as being the three most important elements for businesses when it comes to choosing their TaaS provider as shown in **Figure 2.2**.

Figure 2.2 Key purchase criteria for TaaS



Source: Technavio

The Rise of Consumer Asset Tracking

Many consumers are now implementing tracking technologies into their homes and lives seeking greater control of their everyday. The location of family members, pets, vehicles and possessions (such as luggage, keys and electronics) can be conveniently monitored to ensure their safety and provide peace of mind.

According to Berg Insights' January 2024 Consumer Asset Tracking Systems report, the consumer asset tracking market within Europe and North America alone was valued at EUR1.6 billion in 2022. This is expected to increase to EUR3.8 billion by the end of 2027, showcasing an annual growth rate of 18.9%.

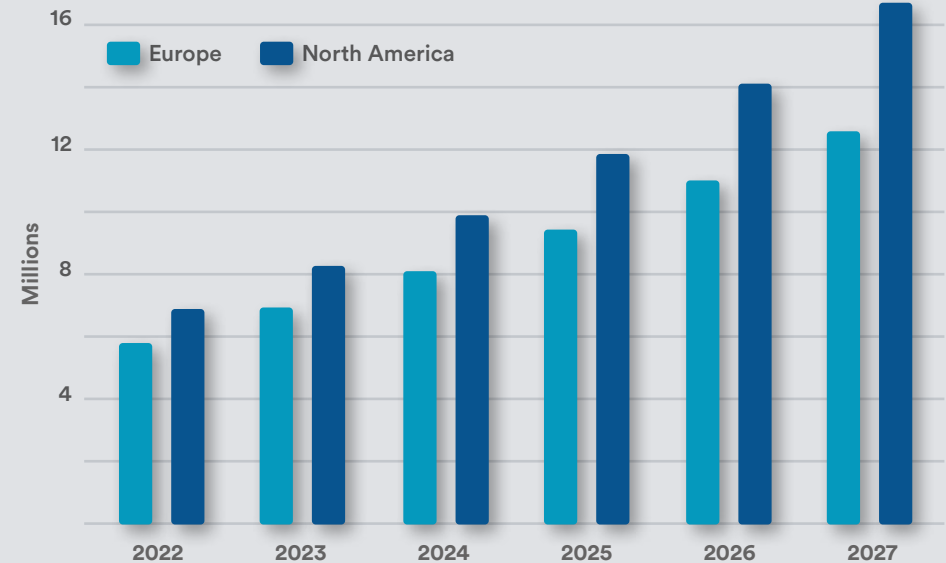
Meanwhile, the number of active consumer asset tracking devices within these regions is expected to increase from 12.5 million units in 2022 to 29.2 million in 2027, at a CAGR of 18.4%. North America held the higher share of the market and is projected to extend its lead over Europe during the forecast period, as shown in

Figure 2.3.

The number of asset tracking devices in the Asia-Pacific and LAMEA region is smaller, but still offers significant potential for growth.

Extrapolating from the Europe and North America forecast, Beecham Research estimates that the global installed base of active consumer asset tracking devices was 23.4 million in 2022. This is anticipated to increase at a CAGR of 14.8% to reach 72.1 million active devices in 2030.

Figure 2.3 Installed base of active consumer asset tracking devices (Europe and America 2022-2027)



Source: Berg Insight

Lack of technology standardisation to hinder implementation and scalability

One major challenge facing asset tracking is a lack of standardisation and regulation across technologies, products and software. Integrating new asset tracking solutions with existing business platforms can be challenging and require significant advance planning. The time and manpower required to do this can be expensive and a hindrance, thus limiting implementation.

However, if businesses rush into deployments without considering these factors, interoperability and scaling issues may arise further down the line. This can result in costly amendments, or the project being written off as a failure.

Data Security Concerns

With a greater number of IoT devices in the field comes greater risk of security breaches. More devices and more complicated software solutions can provide malicious attackers with more options and points of entry.

Furthermore, as a greater amount of data is collected, stored and transmitted, businesses must take greater care to ensure that sensitive information is safe. If there are vulnerabilities, it heightens the potential of unauthorised access, compromising the security of the assets, customers or wider organisation.

Opportunities

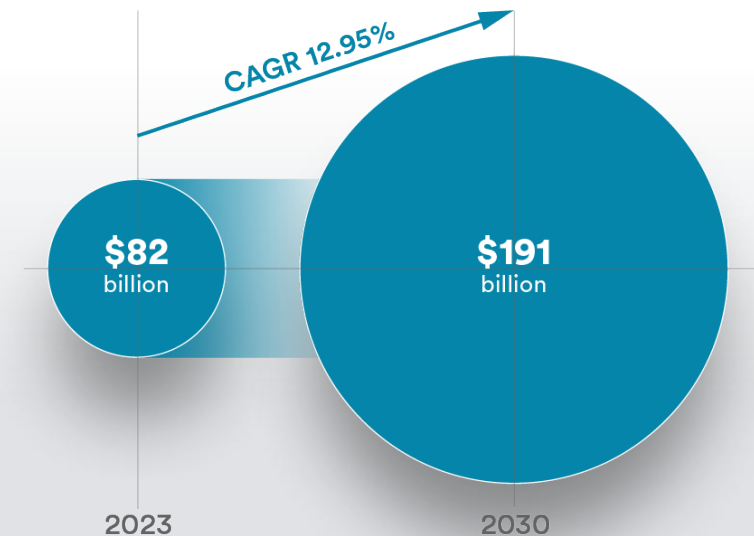
The size of the overall asset tracking market is substantial, comprising around 24% of the total IoT market value in 2023.

Included in this valuation is all location tracking applications, although some devices may also capture data on other attributes. It does not include applications where location is not monitored, such as condition monitoring and status monitoring.

The expected revenue values and growth rate for the 2023-2030 forecast period are shown in **Figure 2.4**.

In terms of IoT connections, Beecham Research estimates that the number of active installed IoT asset tracking devices was 4.5 billion in 2023. This is predicted to increase to 14.0 billion in 2030 at a CAGR of 17.6%.

Figure 2.4 Expected revenue values and growth rate 2023-2030



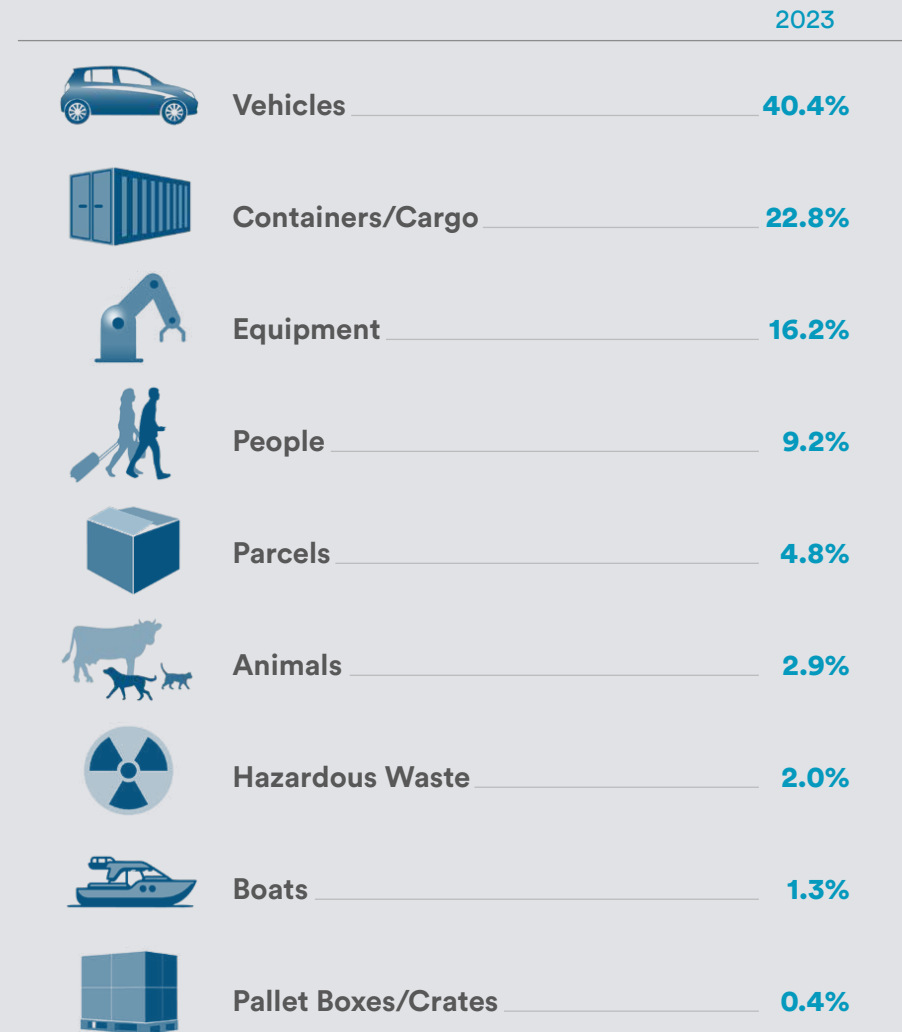
Use Case Segmentation

This analysis segments asset tracking into the following use case categories:

1. Pallet boxes/crates
2. Parcels
3. People
4. Animals
5. Equipment
6. Boats
7. Vehicles
8. Containers and cargo
9. Hazardous waste

As shown in **Figure 2.5**, vehicle tracking represents the largest proportion of the global IoT asset tracking revenue in 2023. This is driven largely by fleet management needs. As well as the application being widespread, added-value devices are more common in vehicle tracking, further boosting the revenue share.

Figure 2.5 Asset tracking segmentation by use case

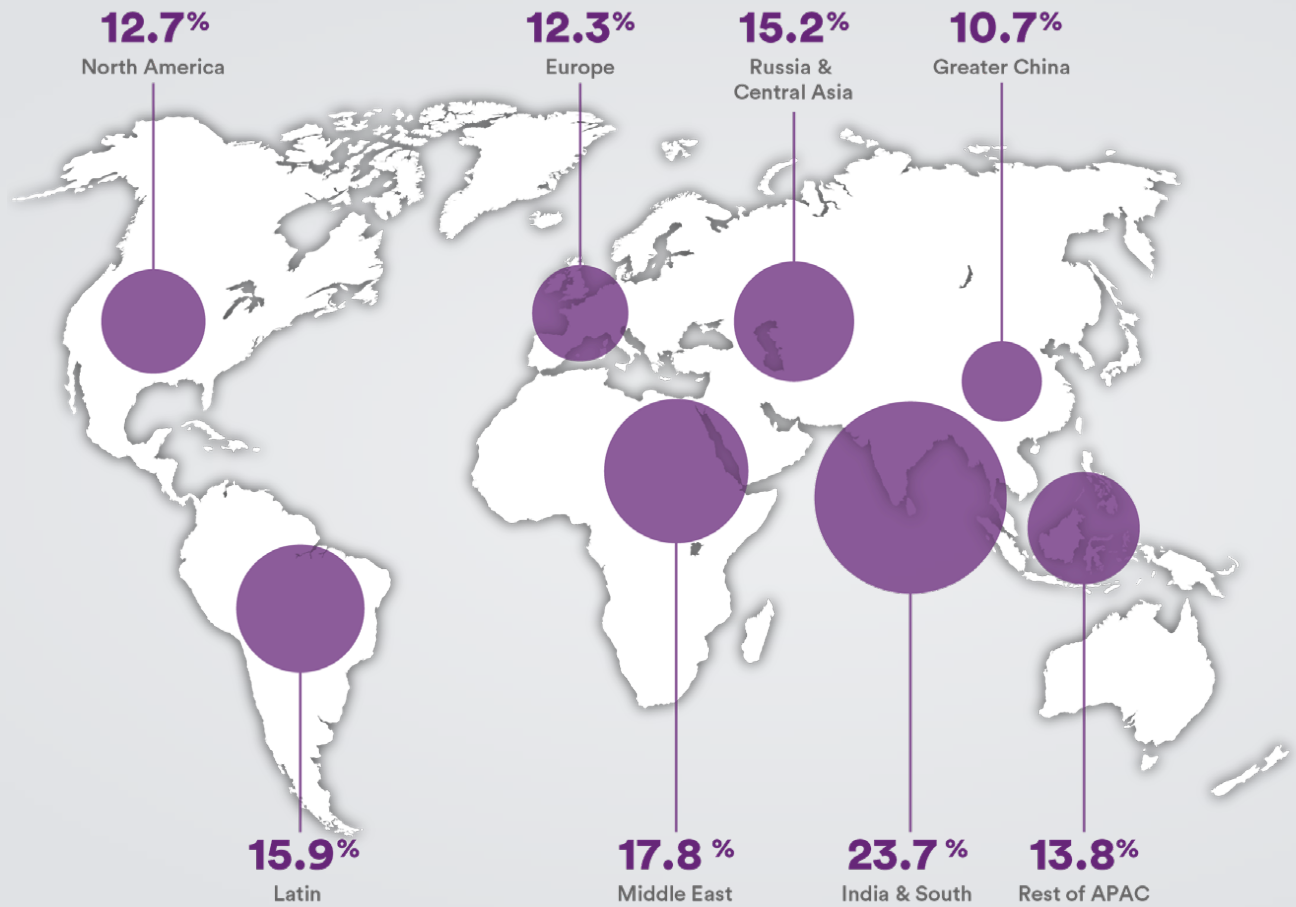


Regional Split

Although around a third of the world’s IoT connected devices are located in Greater China, it is North America that holds the greatest regional share of asset tracking devices, responsible for around 28% of the revenue in 2023.

Figure 2.6 Asset tracking devices regional growth rates 2023-28

	CAGR	Proportion of Total		
	2023-28	2023	2028	2030
Greater China	10.7%	25%	23%	22%
Europe	12.3%	24%	23%	23%
North America	12.7%	28%	28%	28%
Latin America	15.9%	4%	5%	5%
India & South Asia	23.7%	2%	4%	5%
Russia & Central Asia	15.2%	2%	2%	2%
Middle East & Africa	17.8%	2%	2%	3%
Rest of APAC	13.8%	12%	13%	13%
Total CAGR	12.95%			
Total Revenue (USD		81.5	149.0	191.2
billions)				



Together, North America, Europe and Greater China dominate the regional revenue share within IoT asset tracking, holding more than three quarters of the total revenue. This is due to these regions being highly populous and wealthy, enabling them to invest in advanced technological solutions.

However, the most dynamic growth is expected to be seen in the India and South Asia region. India is one of the fastest-growing economies worldwide and is rapidly building its reputation as a technology and services hub. It is also a highly populous country.

Middle East & Africa is set to see the second fastest growth over the forecast period thanks to its rapid population growth and the low base it is growing from.

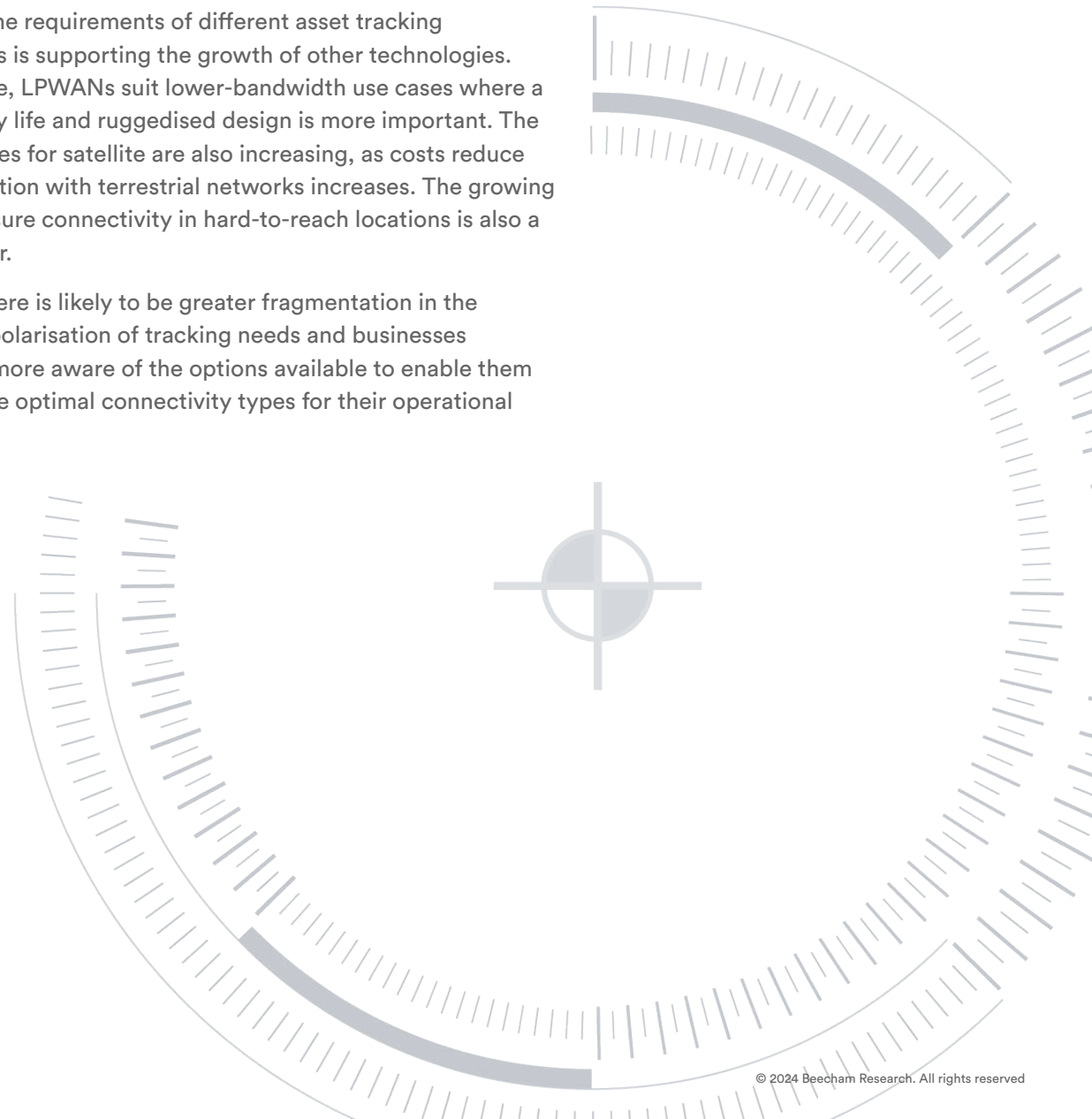
Connectivity

In terms of connectivity, the market is becoming increasingly diverse, not least because many solutions now use a combination of connectivity types.

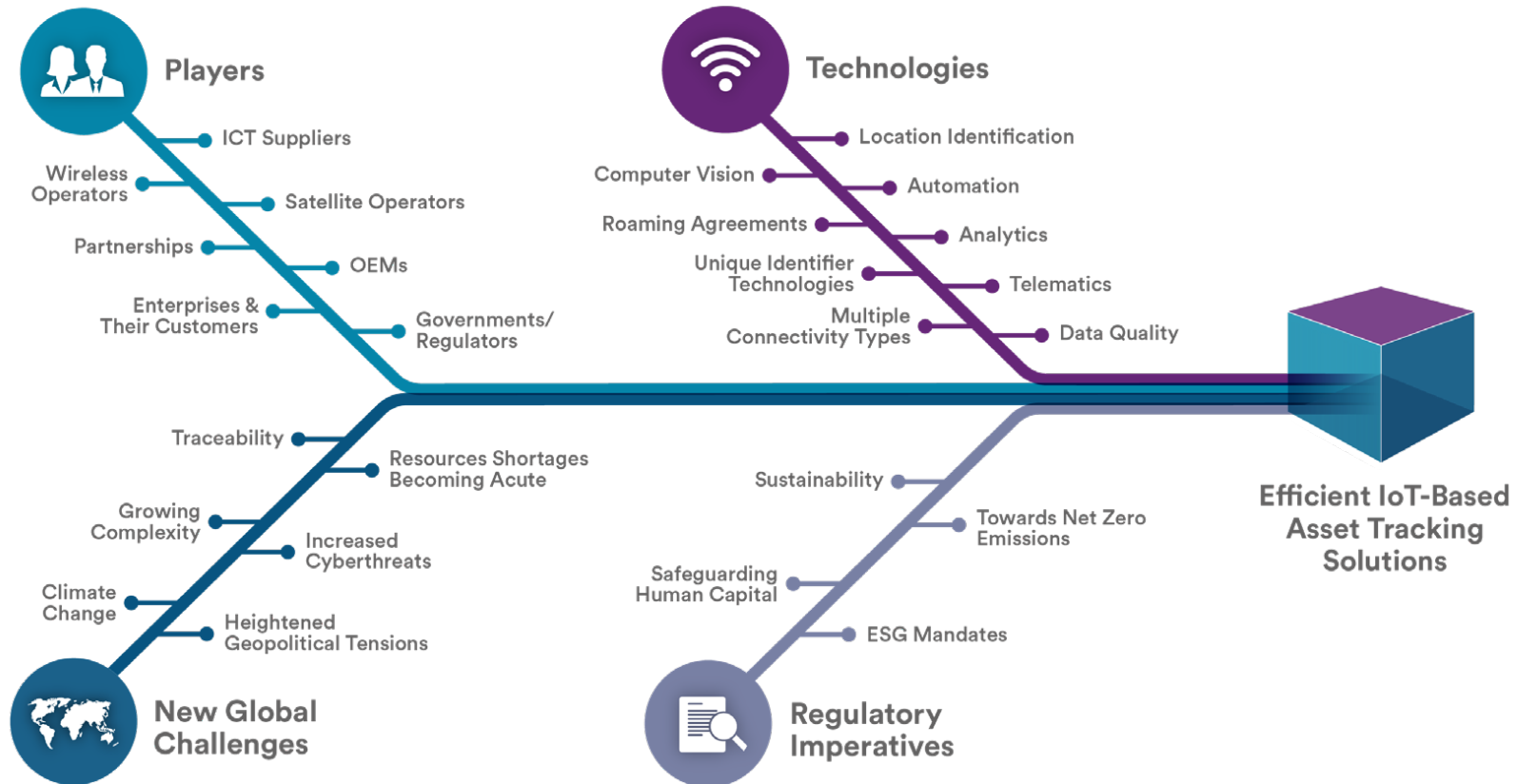
Cellular will likely remain the most well-known and popular group of connectivity types, with its established infrastructure and the multi-SIM options offering a convenient set up. The introduction of 5G (including New Radio) is effective for realtime tracking, especially if additional high bandwidth data capture is required.

However, the requirements of different asset tracking applications is supporting the growth of other technologies. For example, LPWANs suit lower-bandwidth use cases where a long battery life and ruggedised design is more important. The opportunities for satellite are also increasing, as costs reduce and integration with terrestrial networks increases. The growing need to ensure connectivity in hard-to-reach locations is also a major factor.

As such, there is likely to be greater fragmentation in the market as polarisation of tracking needs and businesses becoming more aware of the options available to enable them to select the optimal connectivity types for their operational needs.



Multidimensional Factors for Achieving Efficient IoT-Based Asset Tracking Solutions



The Ishikawa or Fishbone or Cause and Effect diagram is a wider view of all the factors involved in IoT-Based Asset Tracking, includes not only the technology and the influencers that spring to mind most readily, but also the economic, regulatory, political, environmental, legal developments as well, to illustrate the full picture of how this outcome is made possible.

Important to note are the factors that contribute for extending local short range asset tracking solutions to continental and global tracking solutions. Challenges faced by shippers in regard to different regulations in the countries in which their solutions will operate, not to mention the geopolitical issues influencing all dealings worldwide during the mid-2020s.



Players

ICT suppliers

ICT comprises the full set of Information Technology and Communications technologies – hardware, software, and various tools and services (e.g. Software as a Service). The growing complexity and scale of IoT solutions necessitate skilled solution providers and systems integrators, with additional subject matter expertise for the industry in question.

Wireless Operators

Cellular technologies are the primary wide area technology for collecting data from a wide range of devices across a range of industries; these cover 4G, 5G, private cellular networks, Low Power Wide Area (LPWA) technologies, (including NB-IoT and Cat-M) and Wi-Fi. For tracking operations, devices with a longer battery life will have the advantage.

Satellite Operators

The number of options for IoT using satellite connectivity is increasing dramatically, in particular with integration of satellites/non-terrestrial networks (NTN) and terrestrial networks. Satellite imagery is also increasingly used for applications relating to geolocation, environmental applications and examination of large areas including fields and woodlands and long distance tracking across continents and oceans.

Partnerships

Partnerships come in many forms, depending on the desired skillsets needed to complement an operator's offerings. Partners need to provide active collaboration to bring innovative solutions to market or extend the reach of their services. This may include networking, roaming, solution or technology partners.

OEMs

Original Equipment Manufacturers make products and parts used by other suppliers to create their own goods. OEMs work in a variety of sectors, including automotive,

electronics and aerospace. For example, vehicle manufacturers will purchase a tracking system for incorporation into their vehicles.

OEMs of industrial equipment are adapting themselves and their products to today's digital economy. While they typically offer maintenance or other after-sales services, they also use IoT-based preventive maintenance to analyse data from their own equipment. This enables them to garner actionable insights they can use to improve it before it develops a fault.

Enterprises & Their Customers

These organisations commission projects, while the user community provides feedback for developers regarding usability and other issues. Investors provide funding for new R&D, applying risk and opportunity assessment techniques to estimate risks to a capital venture. Enterprise customers must know how to purchase IoT systems, deal with suppliers and hire personnel who have the skills to develop and manage them.

Governments/Regulators

This category comprises national, international and industry regulators who specialise in safeguarding particular industry segments. They set standards, rules and protocols for emerging technologies and prevent powerful corporations and untried technologies dominating the market. Regulators must always keep up with changing innovations in technology, particularly IoT.

Their staff need a good grounding in the latest technologies to understand both their benefits and risks, in order to provide clarification to the industries concerned. Regulators can differ by region, by sector.



Technologies

Location/Positioning Identification

Location technologies for land, sea and air enable the tracking of equipment, vehicles or ships – in some cases, to a granularity of a few centimetres. High accuracy tracking facilitates more advanced applications such as C-V2X (cellular vehicle-to-everything) and autonomous driving. However, various factors can cause interference in autonomous machines – a challenge in agriculture and other industries where precision and reliability are paramount.

Computer Vision

Computer vision or machine vision is a field of artificial intelligence where computers and systems extract meaningful information from digital images, videos and other visual inputs.

Automation

Automation is a technology-driven approach intended to streamline processes, enhance efficiency and reduce errors, thereby improving operations with minimal human input. In IoT, this includes automatic processing of massive data, reducing operating expenditures and improving efficiency.

Global vs Regional vs Hyperlocal Roaming Agreements

Roaming and hyperlocal agreements enable subscribers to move seamlessly between networks and ensure service coverage in new locations. The former facilitates automatic access to other networks when travelling outside the home network, whilst the latter is based on an array of interconnected local core mobile networks. Local networks typically provide better throughput and latency – a significant factor as use cases develop via 4G LTE and later, 5G.

Choosing the right approach and partners is key to minimising costs and staying aware of geographic roaming regulations.

Analytics

Analytics techniques such as Machine Learning, Artificial Intelligence, Augmented/ Virtual Reality and Machine Vision are used to gain insight from sensor data. Example use cases include digital twins (a 3D computer simulation laid over a true to life landscape) and predictive maintenance (a method of optimising maintenance schedules that limits the

risk of breakages and associated downtime while also reducing unnecessary work on equipment upkeep.

Unique Identifier Technologies

Radio frequency identification (RFID) technology is a tracking tool for inventory and assets. The emergence of real-time networks has enabled RFID data to deliver insights on product status and the supply chain, enabling more accurate inventory tracking.

Telematics

Telematics is a set of techniques used to track vehicles. Several applications are already offered commercially including eCall, driver assistance, connected navigation, motor insurance, road charging, fleet management and vehicle diagnostics. Most notable is LiDAR – a method that determines distances by measuring the time it takes for a laser to hit its target and return. According to MarketsandMarkets, the LiDAR market will be worth \$2.4 billion by 2026.

Multiple Connectivity Types

As the IoT market matures, the range of connectivity types is growing to cater for different data capabilities, generational upgrades, and latency needs. Examples include LoRaWAN, 4G/5G cellular (including 5G RedCap, NB-IoT, LTE-M and fixed wireless), Wi-Fi 6/7, BLE, ZigBee, Z-Wave, as well as wired connectivity. Hybrid options, such as satellite integration with 5G or LoRaWAN, are also becoming more popular. No one connectivity type can cater for all needs – therefore a range of options is essential.

Data Quality

Organisations can only make good data-driven decisions if the data used is correct and suitable for the use case at hand. Poor-quality or missing data can lead to severe issues. According to a Gartner survey, poor-quality data is thought to be responsible for around \$15 million in losses per year. According to IDC, worldwide data volumes are set to grow 61% from 2018 to 2025, to reach 175 zettabytes, with as much being held in the Cloud as in data centres.



New Global challenges

Heightened Geopolitical Tensions

Heightened geopolitical tensions in the 2020s affect supply chain confidence, and pose greater threats to trans-continental trade including international trade policies and tariffs, with companies having to adjust routes due to conflict zones, resulting in greater costs.

Climate Change

The impact of climate change on the global tracking of assets by disruptive weather events is more commonplace than in previous decades. Such events include floods, wildfires, droughts, tropical storms. Flooding and extreme heat are the most widespread impacts of climate change, according to new data released from the CDP (Carbon Disclosure Project), the non-profit organisation which runs the world's environmental disclosure system for cities, states and regions.

Increased Cyberthreats

These come from the ubiquity of Internet connectivity, due to the increase in remote working, more connected devices, and more points of entry for cyberattacks.

Growing Complexity of ICT/IoT & Networks Infrastructures

The growing complexity of ICT, networking infrastructures and digital infrastructure growth is placing connectivity constraints on expanding IoT implementations, particularly in terms of coverage, scalability, reliability and bandwidth.

The Connecting Europe Facility (CEF) programme supports trans-European networks and infrastructures in the sectors of transport, telecommunications and energy. The programme aims to support the development of digital service infrastructures and broadband networks. The programme has received EU funding to support public administrations and their partners.

Resources Shortages Becoming Acute

It is now recognised across the world that resources, hitherto deemed unlimited, are now at risk of running low or running out: these include fossil fuels, minerals, construction materials, foodstuffs and water fit for consumption and agriculture.

Tracking solutions entail high energy consumption by tracking devices and their supporting infrastructure. Using low-power or energy-harvesting technologies can reduce environmental impact. For instance, solar-powered GPS trackers can be used for shipping containers/freight, whilst vibration-powered devices can be used for monitoring the condition of cargo during transit.

Traceability

Stringent regulations across the globe necessitate adopting asset tracking solutions for compliance and standardisation. Track & trace solutions enable visibility into the status and location of items, facilitating inventory management, enhancing security, confirming regulatory compliance, and mitigating the risk of counterfeiting. These systems enable the monitoring of products from production to final delivery by implementing tracking identifiers, such as barcodes or RFID tags.

Likewise the rise in counterfeit products across various industries has resulted in a pressing need for asset tracking to safeguard brand integrity and consumer safety.

In the pharmaceutical industry for example, serialisation and traceability are critical processes to ensure safety; here unique identifiers are assigned to individual units of pharmaceutical products. This makes it near impossible to introduce counterfeit drugs into the supply chain.

In the UK in 2015, a scandal where horsemeat was incorporated into beef products infiltrated many parts of the food supply chain before being withdrawn.



Regulatory Imperatives

ESG (Environmental, Social & Governance) Mandates

ESG is a framework for responsible business practices for the long term: it is not just a slogan, rather a cornerstone of defining good quality, low risk business.

Organisations have been allocating more resources toward improving ESG. Most now publish ESG reports in some form, and reporting ESG elements is either mandatory or under active consideration. A major part of ESG growth has been driven by its environmental component and responses to climate change, while other components like the social dimension have also been gaining prominence. In the context of IoT, ESG considerations include reducing e-waste and the promotion of efficient energy solutions.

Safeguarding Human Capital

Skilled manpower is increasingly scarce, and efforts are underway to safeguard human capital across industries. In transportation, the EU implements rules for working time and driving time; in the workplace health and safety regulations and codes of practice aim to reduce hazards and injuries.

Additionally, there are monitoring services to track lone workers, operating in dangerous locations such as mining, and unsafe parts of town. The demand for IoT based real time monitoring applications is escalating in many areas where it is critical to identify threats rapidly.

Towards Net Zero Emissions

The term Net Zero entails achieving a balance between the carbon emitted into the atmosphere, and the carbon removed from it. This will happen when the amount of carbon we add to the atmosphere is no more than the amount removed. To achieve this, emissions from industry need to be cut, and this is now the focus of government regulation and industry concerns. Different countries have specific goals and recommendations for industrial practices.

The Chartered Institute of Logistics and Transport (CILT) believes its sector can achieve net-zero by 2050 through a range of measures recommended to government and others in its latest report, "Routes to Net-Zero 2050: 2020 Year End Summary". The report includes 21 recommendations for action covering all transport modes and activities.

Sustainability

Sustainability requires that human activities and operations occur without depleting scarce or irreplaceable resources. Different industries define sustainability in different ways. Innovators are applying digital technologies such as artificial intelligence, Internet of Things data, blockchain and hybrid cloud to help operationalise sustainability at scale. IoT is one of the technologies that has the potential to have a positive impact on sustainability, by implementing smart energy management, optimising resources, or reducing waste.

Market Research

Beecham Research is continually researching the IoT market. This section includes recent 1-on-1 interviews with asset tracking market players together with findings from a recent survey.

Asset Tracking Requirements

As part of the research for this report Beecham Research conducted a survey of those using or expecting to use asset tracking in their operations. This was aimed at IoT users in all geographies.

Your Business Unit

Figure 3.1 shows regions where respondent business units are based. Considering time zone split, this breaks down to 39% in Americas, 41% in EMEA and 20% in APAC.

In **Figure 3.2**, the majority of respondents' business units representing 70% of the total have less than 100 staff. 16% then have between 100 and 1000 staff, with 14% over 1000 staff. This represents a significant weighting towards larger companies, since in the market about 85% have less than 100 staff.

Figure 3.1 In which region is your business unit based?

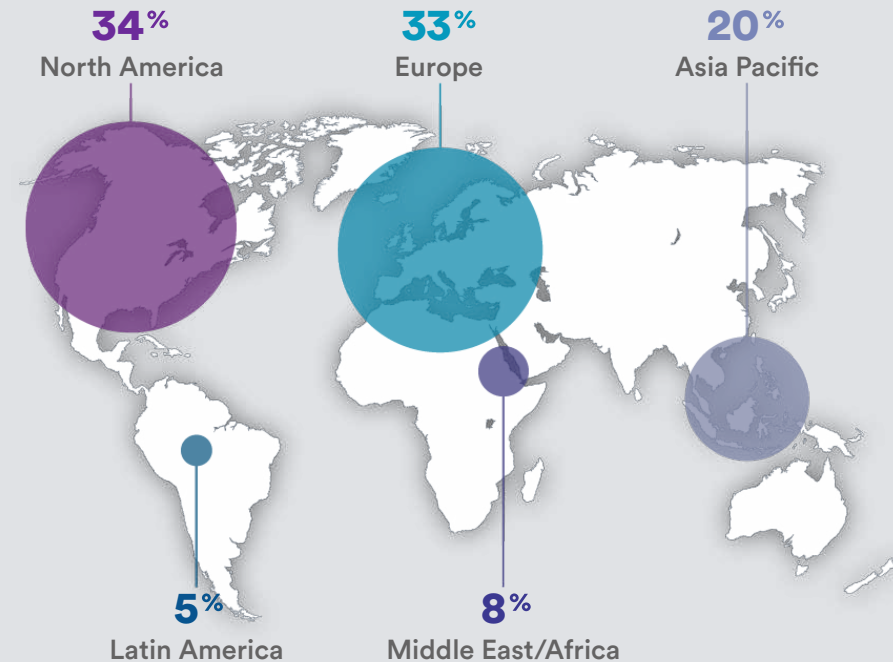


Figure 3.2 How many staff are employed by your business unit?

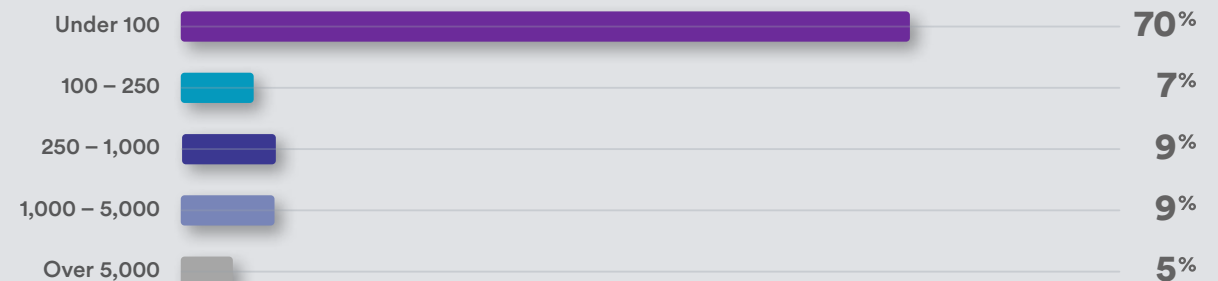


Figure 3.3 shows the organisation level of respondents, with 60% at VP, Director or C level and a further 27% at Manager level.

A wide range of roles were noted in **Figure 3.4**, with Executive Management/Strategy by far the largest category with 38%, followed by Product Development/Design at 21% and Marketing/Sales at 18%. These three combined accounted for 77% of respondents. .

Figure 3.3 What is the organisational level of your position?

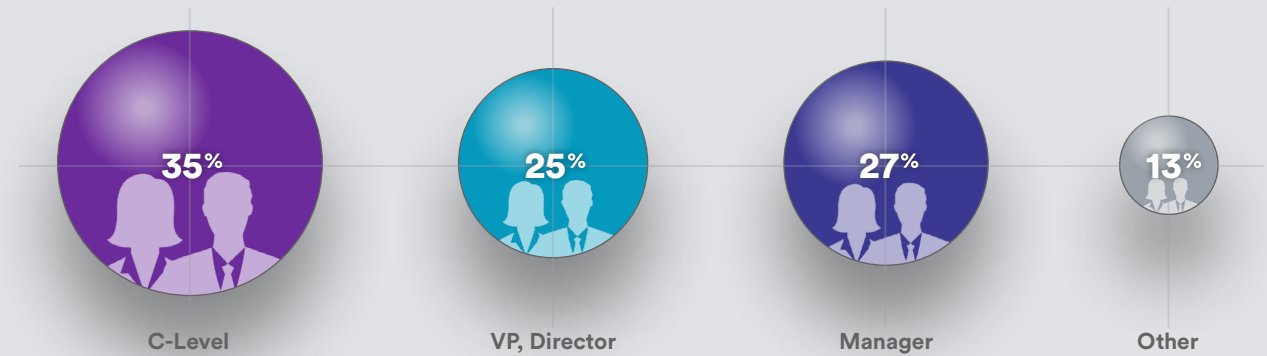


Figure 3.4 What is your principal job function?

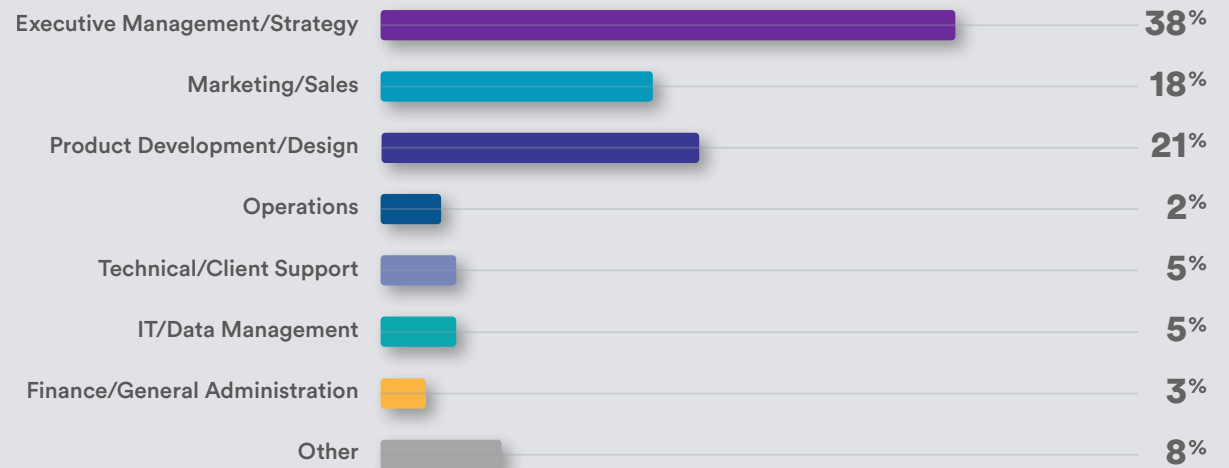
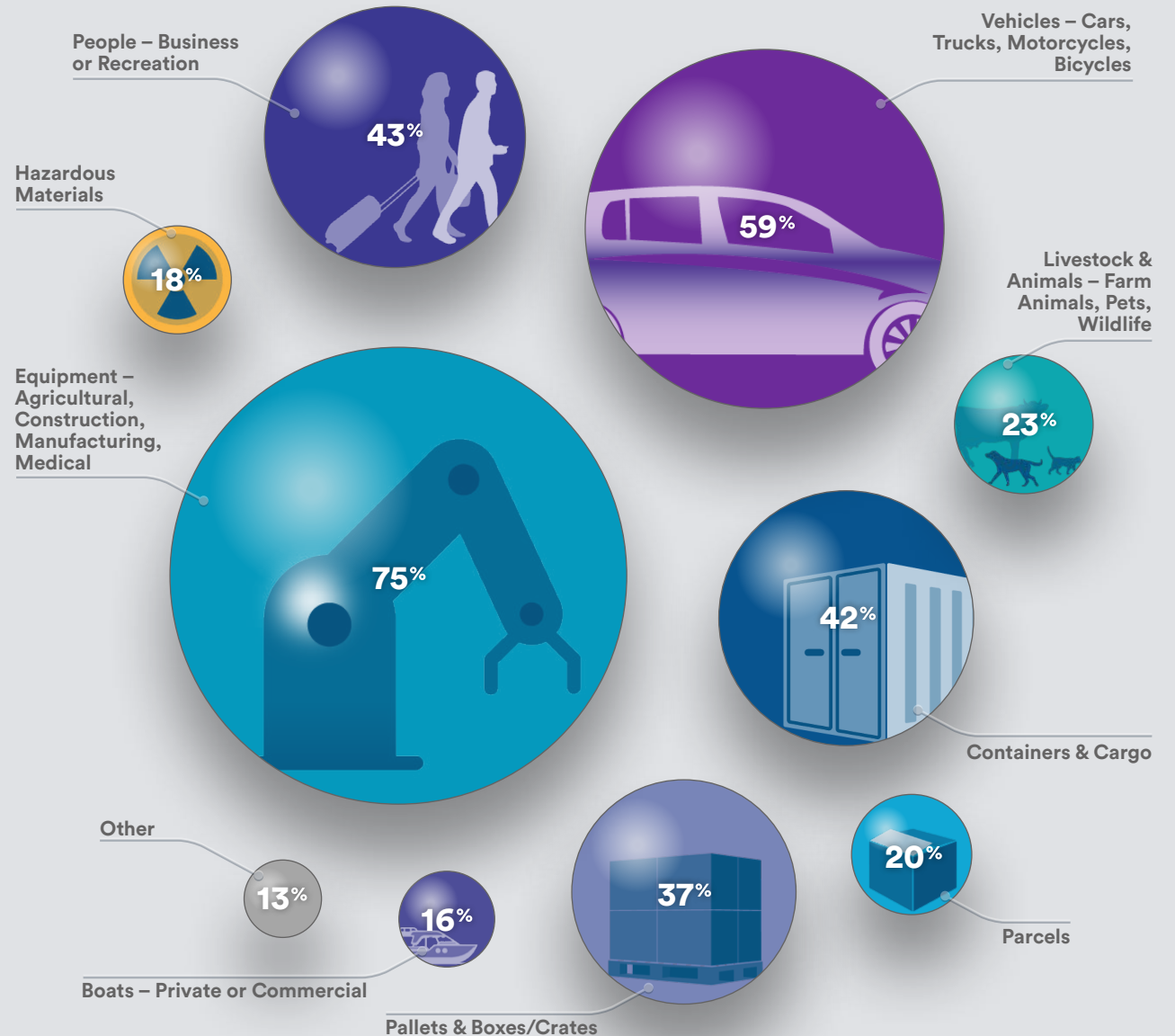


Figure 3.5 shows that Equipment tracking in all sectors (75%) was the most popular form of tracking among respondents, followed by Vehicles (59%), then people tracking both for business and recreation (43%). This includes lone worker as well as recreation in remote locations and mountain rescue. Containers and Cargo scored 42%.

Figure 3.5 What sort of assets do you track now, or have plans to track in the next 24 months?



There is now a high interest in measuring other parameters in addition to location, as shown in **Figure 3.6**, with temperature/humidity scoring significantly the highest at 77%, with Tamper/Theft next at 58% and SOS signalling/automated alerts at 52%.

Figure 3.7 indicates that 57% of respondents considered that asset tracking data being kept highly secure was extremely important. This illustrates that for most respondents tracking data has already become a critical part of business operations. Only 3% of respondents felt that tracking data security was ‘not important’.

Figure 3.6 In addition to location, which of the following if any do you also monitor/record for assets that are tracked?

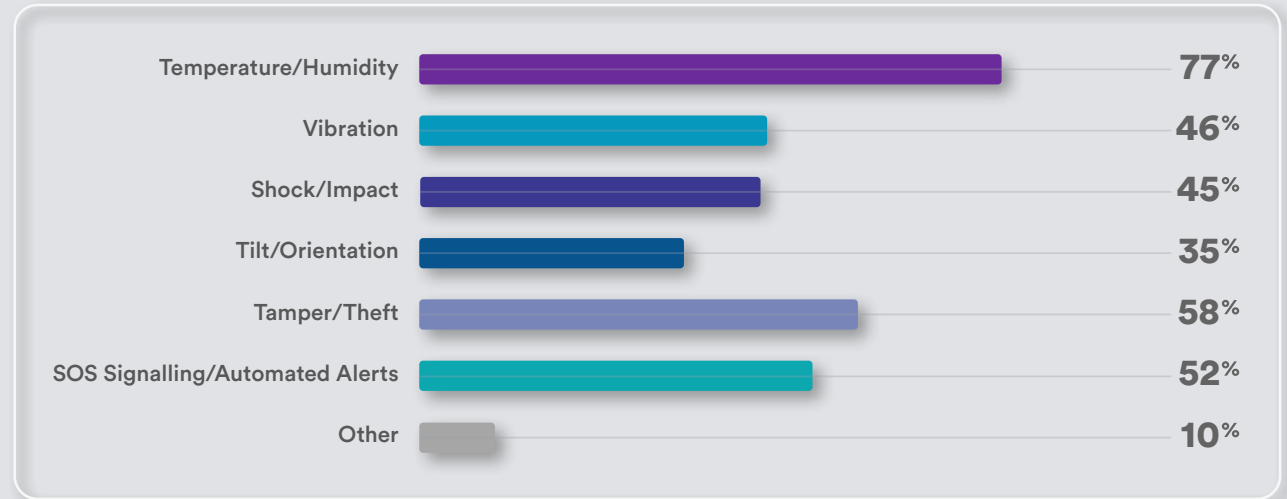
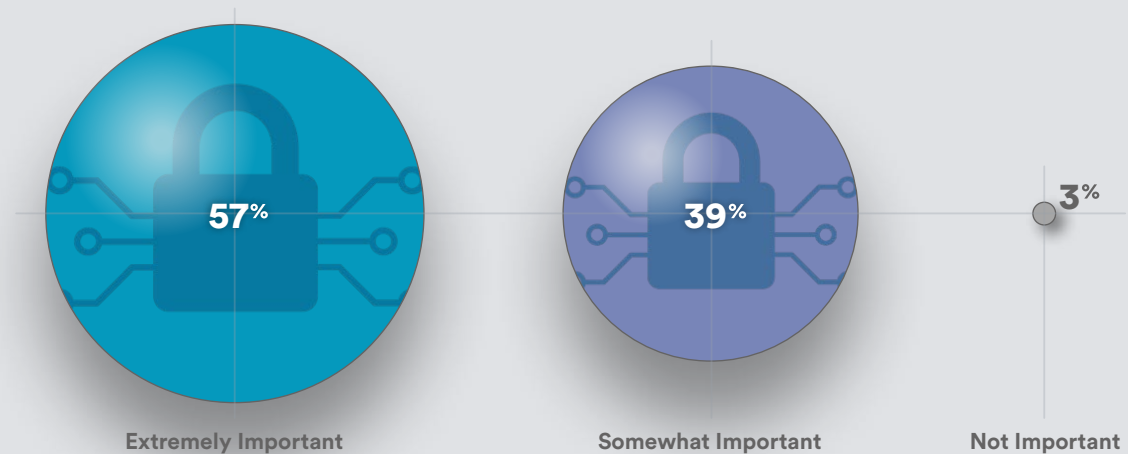


Figure 3.7 How important is it for your operations that asset tracking data is highly secure?



Operations and Activities

Figures 3.8 shows an anticipated high growth in use of asset tracking over the next few years. 75% of respondents anticipated over 10% growth in the next 24 months, with 45% anticipating more than 20% growth.

The purpose of the question in **Figures 3.9** was to establish the coverage requirements for asset tracking data. Local and regional coverage was required by 64% of respondents, with global coverage required by 36%. This is an important finding, as there is a tendency among users to request global coverage even when it is not strictly required. This may unnecessarily limit the technology alternatives available to provide the coverage actually required, which it turn may lead to a higher cost than actually required.



This is a good point. Having a truly global coverage product adds cost in some cellular solutions in order to have global band support. However, LPWA technology like LTE-M makes a global SKU much less complex and less expensive.



Figure 3.8 How do you expect the need for asset tracking in your business to change over the next 24 months, in terms of number of connected items?

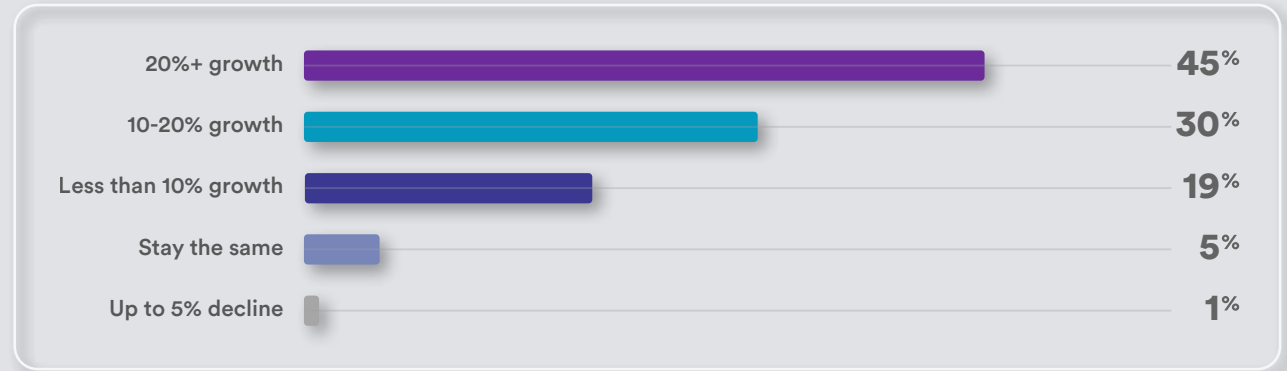
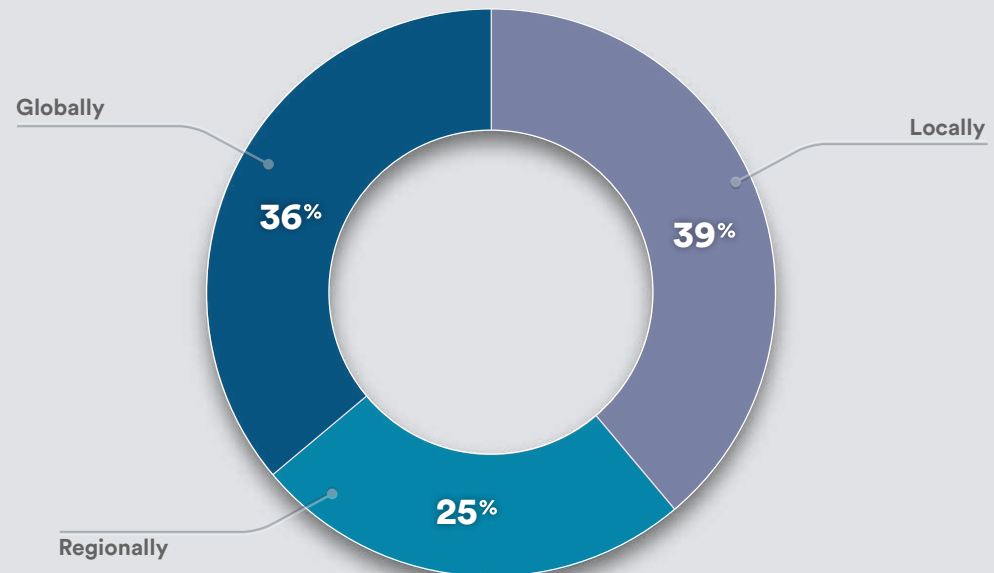


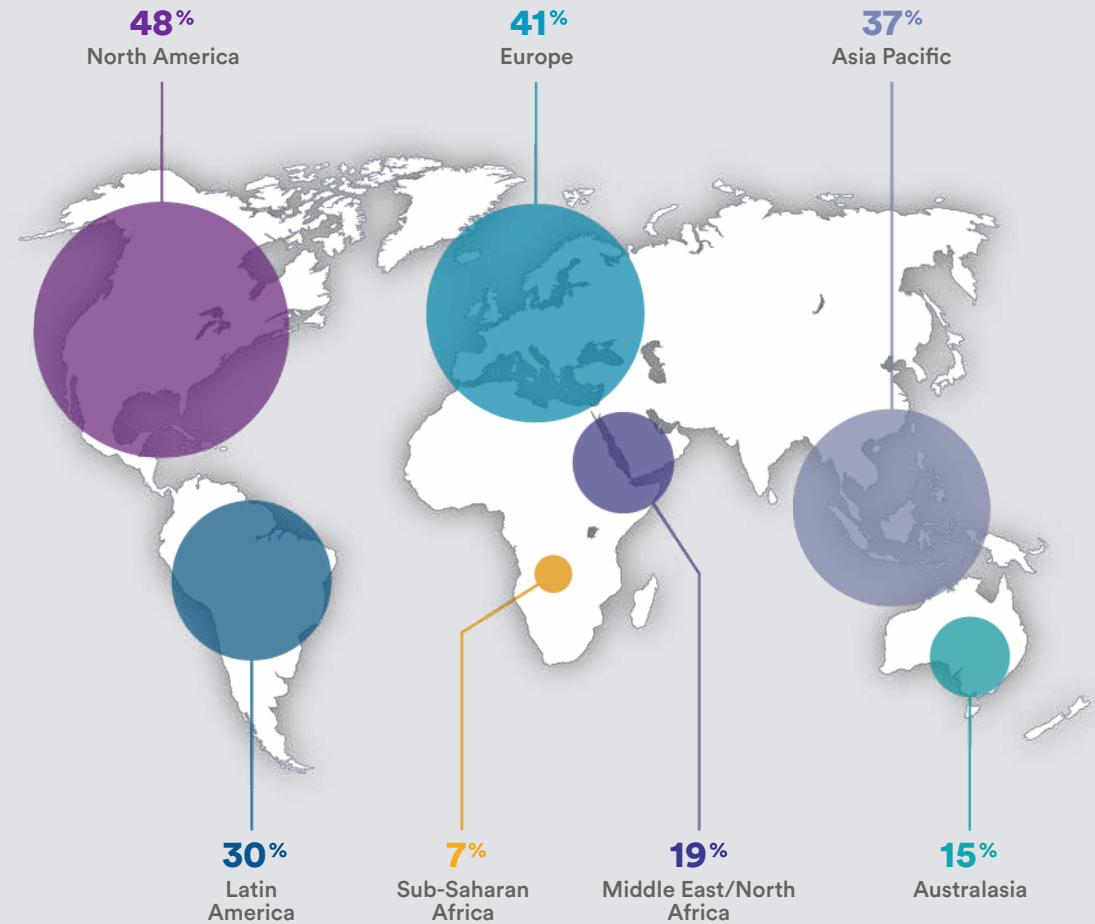
Figure 3.9 In your normal operations, is this asset tracking required locally (within country), regionally (e.g. across Europe, across North America), or globally?



Regional Asset Tracking

Figure 3.10 was asked of those who responded with the need for regional coverage in Figure 3.8. The regions with highest score were North America with 48%, followed by Europe with 41% and AsiaPac with 37%.

Figure 3.10 Which of the following regions do you track assets within?



Benefits

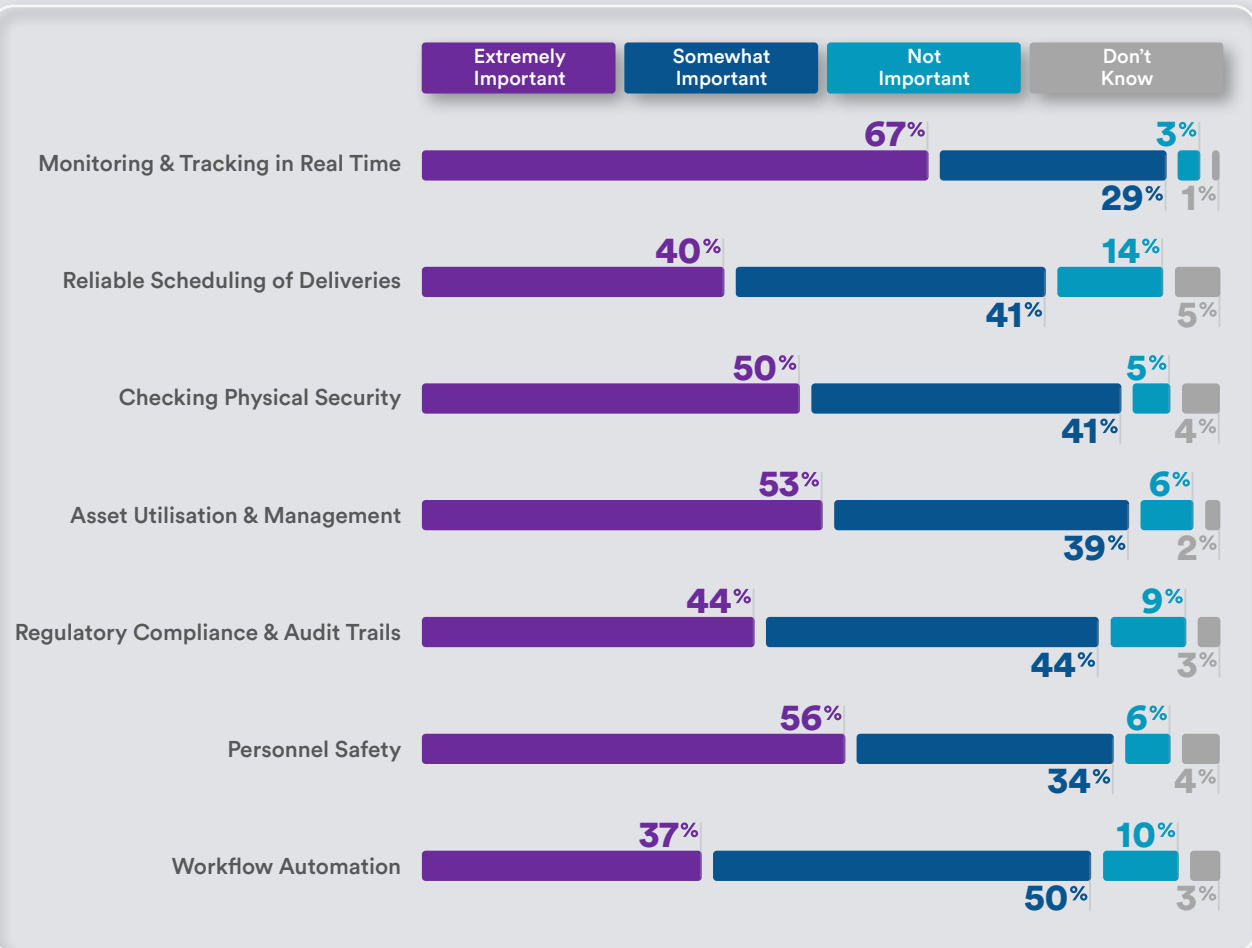
In **Figure 3.11** respondents were asked how important different benefits were for an effective asset tracking solution for their businesses. Monitoring and tracking assets in real time was the top scorer by a clear margin, followed by personnel safety, then asset utilisation and management, followed by the ability to check physical security.



Although monitoring and tracking in real time scores highly, there is a trade-off between this and power consumption. For many tracking use cases, it is acceptable to have “quasi real-time” tracking with a delay of up to a few minutes, especially for use cases where battery life needs to be longer than a few years.



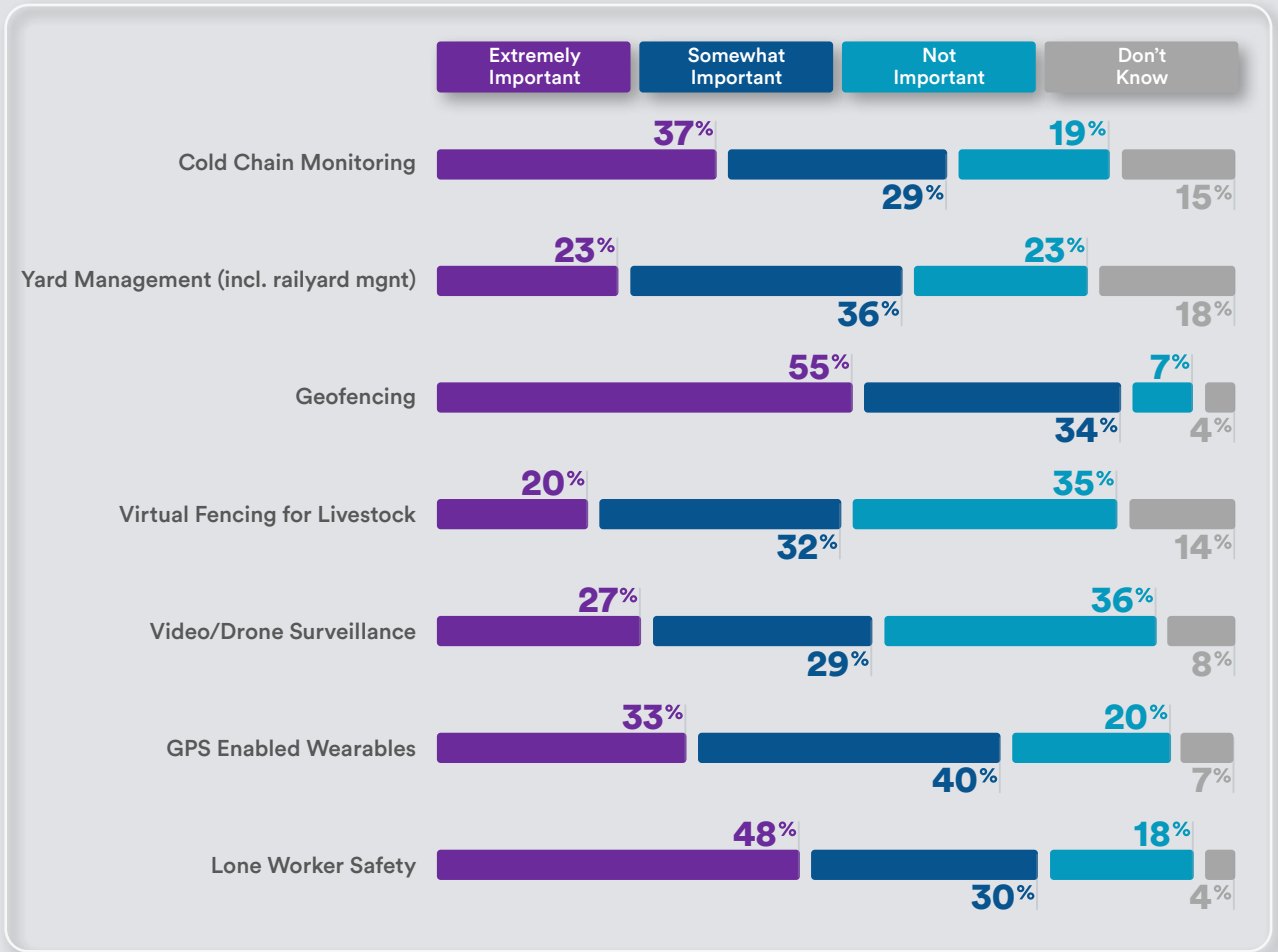
Figure 3.11 How important are the following benefits of an effective Asset Tracking solution for your business?



Application Areas

Figures 3.12 then looked at application areas within asset tracking. Of these, geofencing was considered the most important, followed by lone worker safety. These choices are highly consistent with the findings in Figure 3.11 and earlier findings.

Figure 3.12 How important are the following application areas for your Asset Tracking solution?



Connectivity

Questions related to connectivity use were split into short range and long range.

Figures 3.13 shows an almost equal top score for Wi-Fi and Bluetooth use. Mesh networking and RFID are important for particular applications but not as generally applicable as the first two technologies.

As shown in **Figures 3.14**, Long range connectivity is complementary to short range, with both increasingly being used together in asset tracking solutions. Not surprisingly, given its wide availability and recognition, cellular scores the highest. LoRaWAN is increasingly being used for asset tracking, both onsite and in wide area situations where the capabilities of LoRaWAN roaming are now becoming better recognised. Satellite use for asset tracking is currently more specialised but set to grow strongly over the next few years.

Figure 3.13 What types of short range connectivity do you use for asset tracking?

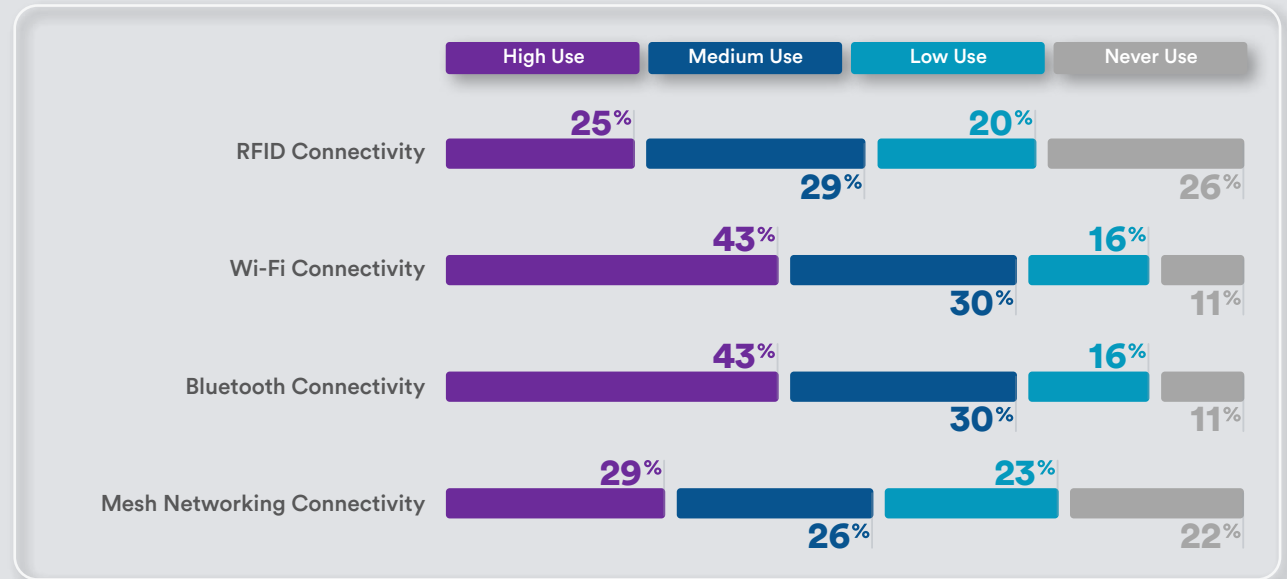
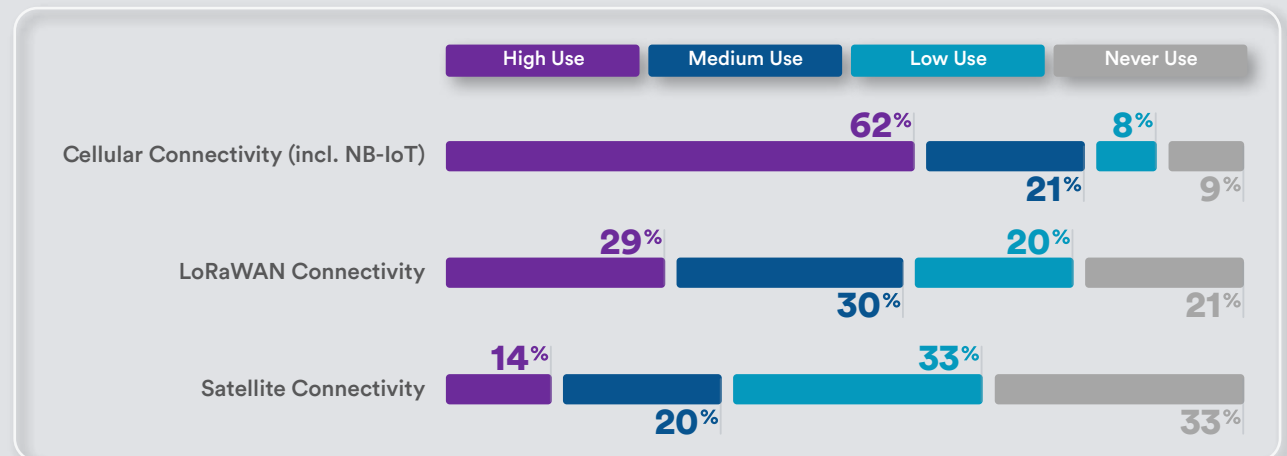


Figure 3.14 What types of long range connectivity do you use for asset tracking?



Multi-Connectivity Approach

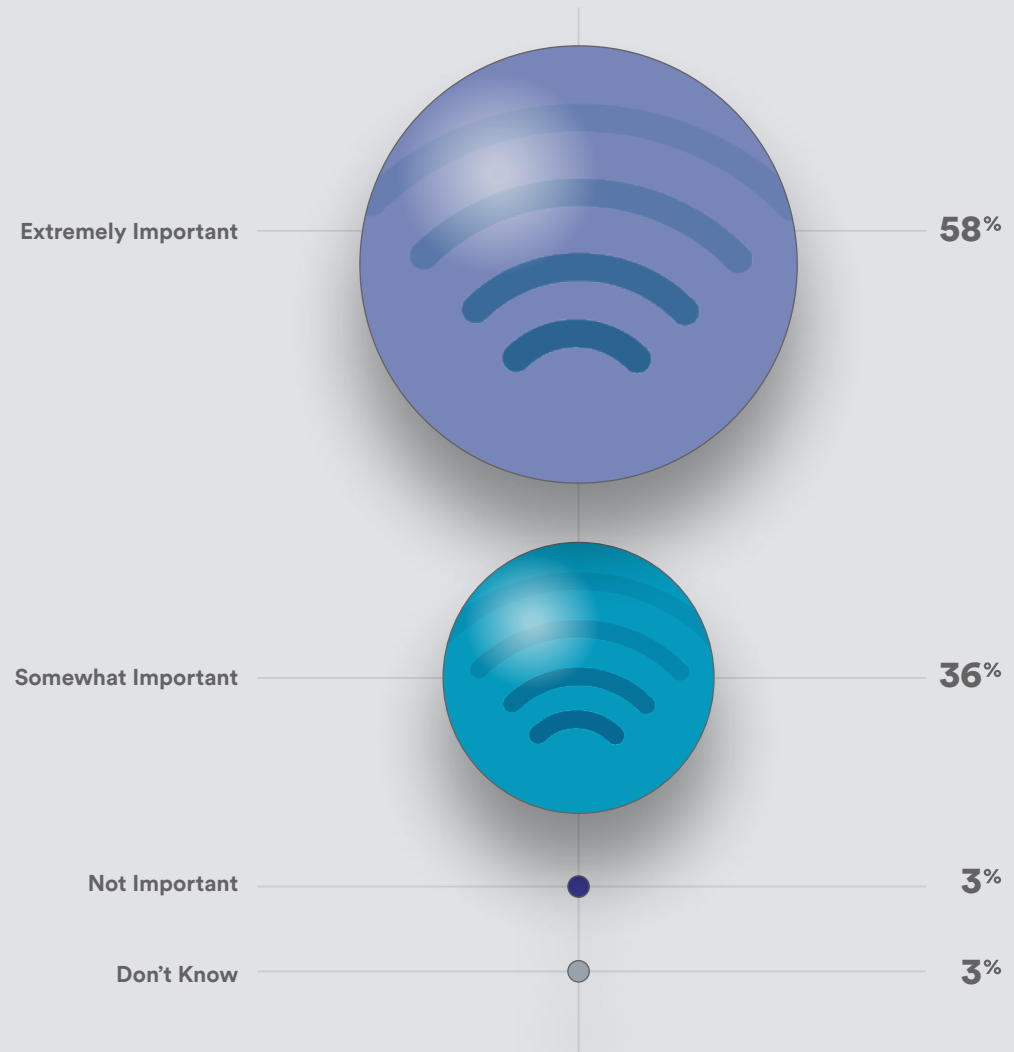
In **Figure 3.15** respondents were asked how important it is to bring short range and long range technologies together for asset tracking solutions. 58% considered it extremely important, with a further 36% considering it to be somewhat important. Only 3% considered it not important.



We are seeing similar findings to this survey result regarding discussions around integrated solutions with LoRa, cellular and NTN connectivity.



Figure 3.15 How important is it to bring together different types of short range and long range connectivity for the tracking of your assets?



Multi-Connectivity Approach

In **Figure 3.16** respondents were asked a follow-on question to that in **Figure 3.15** – the perceived benefits of combining different connectivity technologies. Three responses stood out as highest scoring. Collection of data at low cost with backhaul for the data scored 79%, followed by enhanced coverage at 76% and enhanced asset tracking capabilities at 67%.

Related Findings from Previous Survey

A previous Beecham Research survey conducted in 2024 showed relevant findings for this report related to use of eSIM for cellular connectivity.

Figure 3.17 shows the expected high use of eSIM among cellular IoT users over the next 24 months. Nearly 62% of respondents expected 25% or more of their new cellular connections will use eSIM in the period – a high projected level of use.



eSIM offers business flexibility, product longevity and TCO optimization. It is especially useful for long-lived connected products like smart meters, which are more complicated to deploy today. When the new IoT eSIM SGP .32 standard is available in 2025, it will be much easier for more IoT use cases to benefit from the technology.



Figure 3.16 Which of the following benefits do you think can be realised by combining various connectivity technologies for asset tracking?



Figure 3.17 To what extent are you currently using or planning to use eSIM in your IoT solution within the next 24 months?

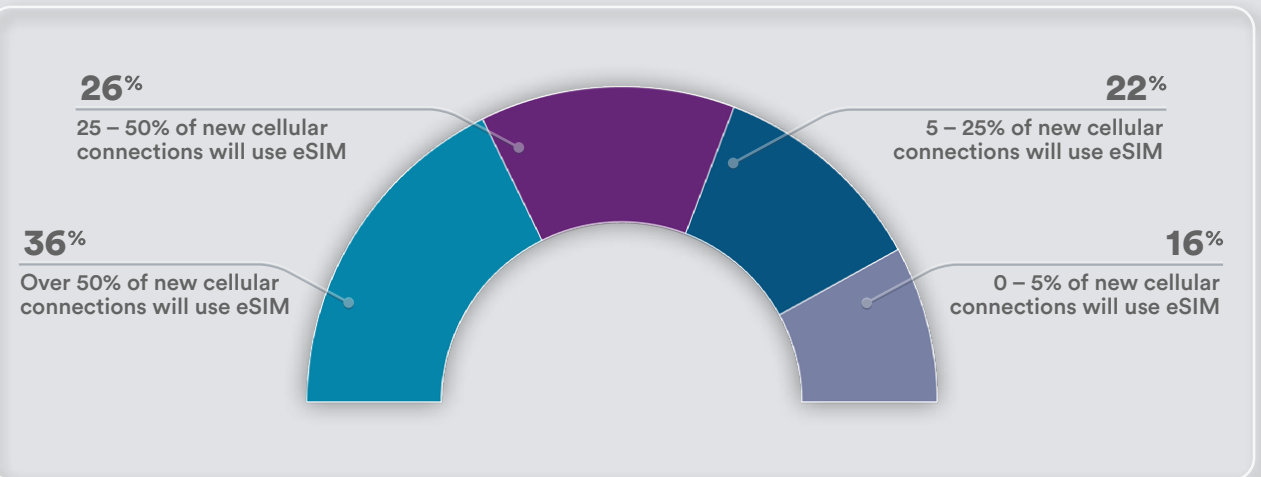
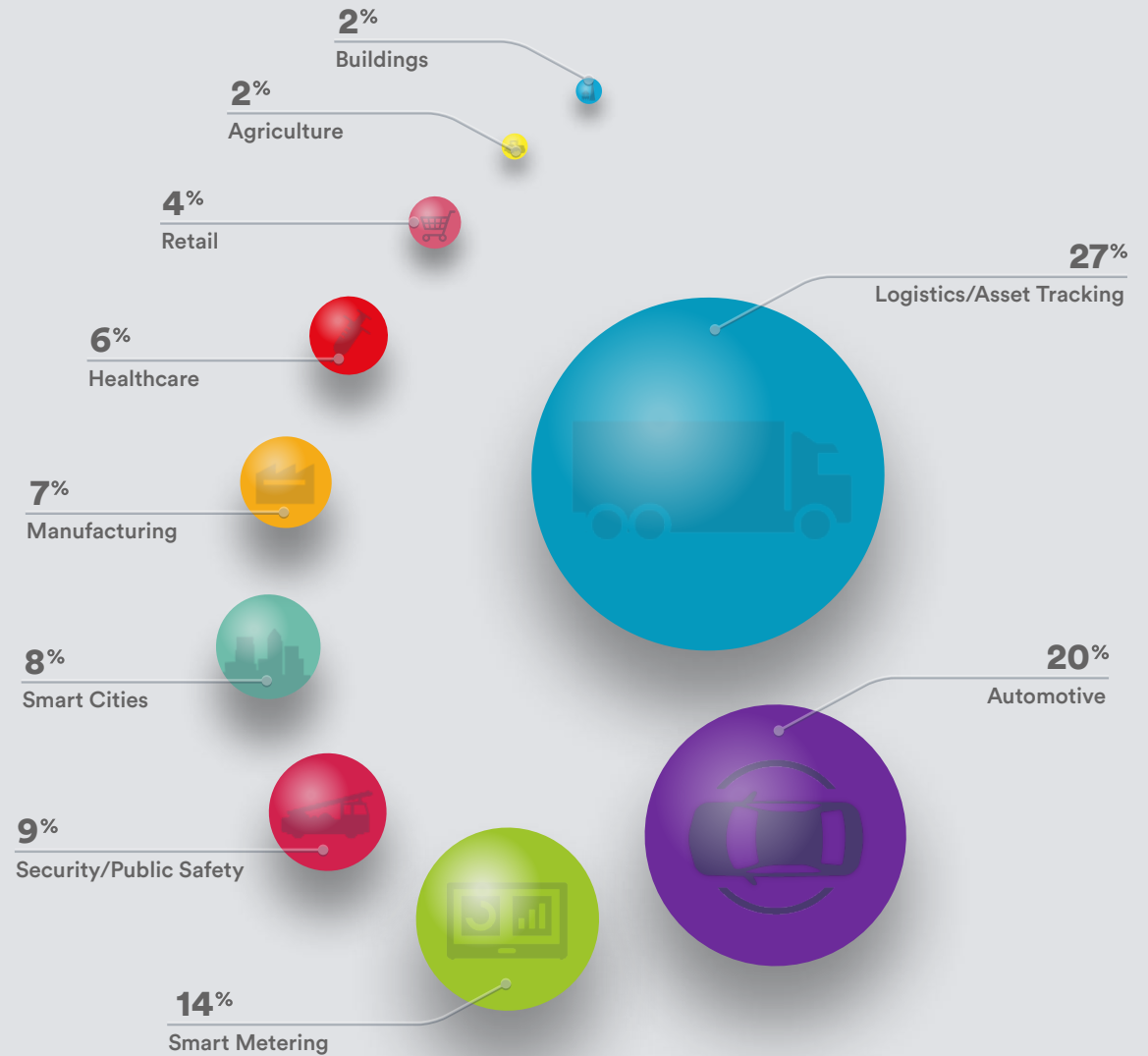


Figure 3.18 then provides an indication of which sectors these eSIMs will be used in. Automotive was expectedly high at nearly 20% since eSIM was originally designed with this sector's requirements in mind. The highest expected use, though, was in Logistics/Asset Tracking, scoring nearly 27%. This is a highly significant finding.

Figure 3.18 In which sector is your most important use case for eSIM use?

















Industry Expert Interviews

Questions

1. What drives your clients towards Asset Tracking solutions?
2. What are the top challenges being solved with Asset Tracking solutions?
3. What are the most common technologies used with Asset Tracking solutions?
4. Which regions do you cater for, and which have the highest demand for your Asset Tracking solutions?
5. What particular application areas are in high demand for Asset Tracking solutions?
6. From your experience, in which situation could using satellite be worthwhile for your business? What cost level compared with cellular must satellite technology reach to consider using it in high volume?
7. How do Asset Tracking solutions improve supply chain visibility and efficiency?
8. How are IoT data analytics being used to provide insights from Asset Tracking data?
9. What ROI can be expected from Asset Tracking systems?
10. What trends are you seeing with Asset Tracking systems?
11. How do you see Data Security and Privacy Concerns in the Industry?



Interviewees were all senior executives from:

-  *IoT Expert, B2B Connected Product & Services*
-  *Technical Director, IoT Applications Provider*
-  *Regional Sales Director, Cellular IoT Supplier*
-  *VP, Commercial IoT Applications Provider*
-  *Regional Sales Director, Cellular IoT Solutions*
-  *President, Satellite IoT Connectivity Provider*
-  *Regional Sales Manager, IoT Module Maker*
-  *CEO, Supply Chain Software Supplier*
-  *SVP, Smart Tracking Mesh Networking Provider*
-  *Sales Manager, Logistics Software Supplier*
-  *Area Sales Director, Supply Chain Software Provider*
-  *Senior Executive, Low Power IoT Connectivity Provider*



Question 1. What drives your clients towards Asset Tracking solutions?

Asset tracking via IoT connectivity has grown in scale and geographic reach. In parts of the world where there is no wireless coverage, satellite is taking hold. 85 percent of the Earth's surface has no cellular connectivity, and that includes huge parts of the ocean and land where there is very low density of population. Assets are moved across these areas frequently, necessitating satellite tracking.

The most important requirement for asset tracking solutions is to provide visibility of the assets that are being transported at all times where they are moving (traceability); predictability, to know what time they are likely to arrive at their destination. In addition to location coordinates, other data on the condition of the asset/cargo may be collected, depending on the application: e.g. temperature, humidity.

There are both outdoor and indoor tracking solutions. Indoor asset tracking is used on production lines, manufacturing facilities or warehouses. Common technologies used here include, Bluetooth, Wi-Fi networks due to their low cost and high optimisation and accuracy over small distances.

Manual tracking with RFID tags and sensors can track items through different stages of production and warehousing. Some asset makers send usage data back to the supplier.

Precision agriculture is a major application of outdoor tracking, involving the tracking of farm vehicles and livestock. The use of drones for viewing and mapping fields is likely to grow.

Other applications include the tracking of valuable items –

“As people and products are becoming more connected, this also changes sometimes their delivery or service model, such that they're selling things more as a service, then it becomes more important to them to know where their asset is.”



IoT Expert, B2B Connected Product & Services

“There are companies providing car services, car rental companies, company vehicles, commercial transportation, it represents a huge number of connections.”



Technical Director, IoT Applications Provider

“Mainly price makes our offers attractive but also the structure of how we position our offering... it allows companies to treat our service as a component... What does this mean? The moment you become a component within that supply chain, it is important that there is a clear transparency on the TCO so that you can clearly point out on your bill of material at the end; with our offering, we want to make this as transparent as possible so that customers can think of our service not necessarily as a variable cost block, but clearly as a fixed cost block that allows them to have a clear price tag for this component, which comprises management of the data and the transport of the data.”



VP, Commercial IoT Applications Provider

“Precision in activities like fertilizing is crucial. Over-fertilizing can lead to environmental damage and increased costs.”



Regional Sales Director, Cellular IoT Solutions

“For the smart tracking applications in particular, we use the capability of our devices to route data in a very low power mode, in order to ease the installation of the infrastructure for tracking.”



SVP, Smart Tracking Mesh Networking Provider

vehicles themselves, high value parcels, prized pets. Tracking of personnel working in hazardous places entails providing an alarm generating device to call for assistance. Remote monitoring of patients outside of the hospital may be used to send back clinical data, and also provide proof of compliance to regulations.

Question 2. What are the top challenges being solved with Asset Tracking solutions?

Tracking is one of the oldest M2M apps – fleet tracking for fault detection, insurance, predictive maintenance. Cost savings are well recognised.

It's important for companies to show traceability. Having continuous visibility during transit constitutes proof of delivery.

Making the Battery life of devices last longer helps keep down cost, so the cost of hardware and the cost of connectivity has to be kept as low as possible for all business cases. What also affects the power usage is how often you transmit the data. Whenever you transmit, you use power, and that draws the battery.

Roaming issues affect efficiency and costs.


Alternative transmission modes such as mesh, power saving functions save costs. Narrow band can work with a smaller signal level, and also consumes less power,

There is an increasing need to show compliance – for insurance, remote healthcare applications.


“There are companies providing car services, car rental companies, company vehicles, commercial transportation, it represents a huge number of connections.”

 Regional Sales Director, Cellular IoT Supplier


“The main challenge is battery life and there are many ways on how to solve it, but it really depends on the business solution ...Usually, in the asset tracking or any sort of tracking, what defines the power usage is how often you transmit the data.”

 Technical Director, IoT Applications Provider

“The challenge of coverage can be solved through satellite connectivity, and getting that at low cost can be particularly important.”

 President, Satellite IoT Connectivity Provider

“Narrow band can work with a smaller signal level, and also consumes less power, for majority of the customers they use CAT-M for asset tracking.”

 Regional Sales Manager, IoT Module Maker

“The battery optimization or power optimization is the most critical thing there and it comes also to that as you need a roaming solution for those applications and because you cannot those assets are moving internationally.”

 Regional Sales Director, Cellular IoT Solutions

“What defines the power usage is how often you transmit the data.”

 Regional Sales Director, Cellular IoT Solutions




Asset Tracking solutions also enable businesses to improve their productivity, for example farmers can make use of data coming from livestock and equipment to improve workflow because everything is tracked.




“Multi-party logistics – lack of transparency and lack of data exchange doesn’t allow full control over processes.”

 CEO, Supply Chain Software Supplier


“This system that takes a lot of buy in from the organisation that involves a lot of different people in the supply chain... if this is not backed up at very senior levels in the organisations, most of these projects stop after proving that the technology works or at the POC stage. It’s really about justifying the business cases to effectively implement and deploy the solutions.”

 SVP, Smart Tracking Mesh Networking Provider

“What I can hear from my customers is that the rate of the airfreight has become very expensive, and it is more and more difficult to ship from Asia to Europe and from Europe to Asia. Airplanes are constantly diverted to avoid to cross Russia.”

 Sales Manager, Logistics Software Supplier

“It is a data problem, clients have incomplete data. Clients cannot make use of erroneous data. There are few suppliers that can really provide the data necessary from suppliers’ capacity and supplier sourcing all the way through delivery services to the endpoint and have visibility along the way; many claim that they can do but they cannot.”

 Area Sales Director, Supply Chain Software Provider

“Through acquisition companies have different IT infrastructures and they are not compatible, even if their business model is compatible... clients have to accept the evolution of digitalization in an industry that is very poorly digitalized... Multi-party logistics – Lack of transparency and lack of data exchange doesn’t allow full control over processes.”

 CEO, Supply Chain Software Supplier

“What you need to do is to minimise the payload on a device... our software reduces the energy consumption and the data payload by 70% and is not dependent on the network capability.”

 VP, Commercial IoT Applications Provider



Question 3. What are the most common technologies used with Asset Tracking Solutions?

There are several connectivity solutions for tracking. A hybrid solution can be used where the satellite can connect with terrestrial networks using the same wireless technologies such as LoRaWAN, NB-IoT. LTE Cat M can work with battery and the power consumption is low. Cat 1B may also be used because it consumes a little more power.

There are several types of satellite connectivity that can be used. In remote locations low power or solar power are needed.

For indoor tracking Wi-Fi may be used.

Data quantities transferred are changing from kilobytes to megabytes; some suppliers offer high data rates for various use cases.

“For asset tracking, there are two popular technologies; one is Cat M, so LTE Cat M, because it enables systems to work with battery and the power consumption is pretty low; the second one is Cat 1B, it consumes maybe a little bit more power.”



Regional Sales Manager, IoT Module Maker

“2G, NB-IoT, still 3G, LTM and even 4G. It depends very much on the use case, but it's a blend of everything.”



VP, Commercial IoT Applications Provider

Question 4. Which regions do you cater for, and which have the highest demand for Asset Tracking solutions?

Asset tracking is a global business, and services are rolling out across the globe and will soon cover the whole world. The US market is most advanced; companies are demanding to be able to know when their goods will arrive at their destination. Customers also rely on their suppliers to be aware of delaying factors such as strikes or lack of means for transportation. There is also a growing awareness in Europe for the need for monitoring.

“Our satellites have global connectivity essentially... you are not restricted by geography. However, there are questions of licencing around wireless technologies which complicate matters.”



Senior Executive, Low Power IoT Connectivity Provider

“Customer centres there are in a real hurry and they want to know whether if there is any delay in transportation, then they want to know this in advance.”




Regional Sales Manager, IoT Module Maker




Demand for types of application is very regional. For example, healthcare applications are more in demand in developed countries. For construction projects these are expanding in Asia and the Middle East.



“This is a global business and we see tracking happening really everywhere. This is why we can support 174 countries at the same rate..Where we do serve customers is more about settling, provisioning, taxing, billing and all of these provisioning parts.”

 VP, Commercial IoT Applications Provider

“It’s very regional and dependent also on the end application. The expansion of construction is happening more in the Middle East and India, and they’re kind of tracking the workers behaviour and safety which translates into direct gains in terms of efficiency, organisation and so on those construction sites... but for logistics, we are more focused on the US and Germany in particular, where of course you have very large logistics companies that have an international operation.”

 SVP, Smart Tracking Mesh Networking Provider


Question 5. What particular application areas are in high demand for Asset Tracking solutions?

What particular application areas are in high demand for Asset Tracking solutions?

Maritime & logistics is the number one application. Moving cargo, moving goods, moving assets over distance and through multiple environments and scenarios. Also moving the containers themselves.

Livestock tracking in agriculture is important. With one-and-half billion head of cattle in the world at an average cost of about \$1000 each, this application generates a lot of savings, and also provides farmers with information about their animals’ grazing habits etc.

“Maritime and logistics is the number one application. Moving cargo, moving goods, moving objects moving assets over distance and through multiple environments and scenarios... Another big application area is livestock tracking in agriculture. There are one-and-half billion head of cattle in the world and each has a high average value. That gives that a tremendous opportunity in understanding health condition and location, important things that farmers need to understand and know and can benefit from enormously.”

 Senior Executive, Low Power IoT Connectivity Provider

“Theft control. We want to make sure the moment a device is being stolen that you still can track it down.”

 VP, Commercial IoT Applications Provider



Tracking of individual pallets, parcels also – tracking of fresh fruit and veg, and vaccines because of their high value and ensuring there are kept refrigerated.

Tracking for theft control of vehicles, bicycles, caravans are also important. Also tracking parts on assembly lines assets within warehouses to avoid downtime.



“We’re talking to customers who are keen on tracking things like vaccines, and reporting back not only on the location, but also on the on the conditions of storage of the vaccines. We have a partner who have an application where they install an RFID or a set of RFID readers in a truck... every time the door opens in a truck and then when it shuts, it takes an inventory of all the items or parcels in the truck. So you’re constantly reading and understanding the data which can also help with planning and analysis.”



President, Satellite IoT Connectivity Provider

“We have multiple customers that are using the technology for tracking assets within warehouses, one large customer is using us on more than 3000 warehouses. They install small devices on the wall and those small devices serve as location reference for assets that are moving assets. They can deploy very easily and they can save really 10s of kilometres of wires in those installations and of course a lot of time. And they also benefit from the fact that when they install these solutions, they can reduce downtime or have no downtime at all when they install this system. Likewise we are working with automotive car makers that are tracking their parts within their logistics system.”



SVP, Smart Tracking Mesh Networking Provider

“We are working with automotive car makers that are tracking their parts within their logistics system.. you have a lot of stuff that is happening indoors, but you have also applications that is done in other locations. In those cases, our solution extends wherein you have kind of an LTE tracker within the trucks. The value of doing this instead of having it directly connected device to the network is; number 1, power consumption is much lower; and number 2, the price of each of the devices is much lower than an LTE or LoRa, or these types of devices that can actually directly communicate. So instead of having every device communicate directly to the backhaul, you only have one device, the others are meshed and the tracker is active and acting as a concentrator for all of these devices and aggregates all the data coming from the devices and moving that upstream.”



SVP, Smart Tracking Mesh Networking Provider



Question 6. From your experience, in which situation could using satellite be worthwhile for your business? What cost level compared with cellular must satellite technology reach to consider using it in high volume?

While outdoor tracking is well covered by GPS solutions, indoor tracking is harder to deliver on: e.g. warehouse automation and similar use cases in the industrial manufacturing sector. Determining the location of the asset is important when it has a high value or has risks associated with it.

A hybrid solution can connect to local area networks as well as satellite LoRaWAN, NB-IoT etc.

Customers are not at first aware that satellite connectivity is so expensive. Transmission of the data over satellite is much, much higher than the cost of data transmission over the cellular network.

However, our interviewees think it creates a more reliable form of tracking; some solutions are very competitive with cellular, and adding cellular on actually increases the overall cost. Costs can be kept low if only small but necessary data packets are transmitted, or only transit position once a day with approx. a few bytes. If there are worthwhile benefits, the costs are justified, and the lower the costs the better.

“Warehouse and warehouse automation, that’s a big one. Similar use cases as the industrial manufacturing sector, then industrial manufacturing would be another one. I’m kind of focused on indoor here because I feel like outdoor is pretty well covered by GPS solutions today.. I think the holy grail has always been being able to track things right down to the pallet level.”



IoT Expert, B2B Connected Product & Services

“Satellite can complement cellular in terms of coverage, which may ultimately bring down costs. The ability for satellite to be used with LoRaWAN® also may reduce overall costs. Satellite IoT enables that extension and that growing digitization of the whole of the Earth’s surface. It applies to logistics, agriculture, utilities, the energy sector, and environmental monitoring. The cost of satellite is not too expensive. The data is actually small, very cheap to send, very cheap to manage, with low power, low connectivity charges, fairly low device charges. Device charges will come down as this grows and people will start producing in millions not thousands.”



Senior Executive, Low Power IoT Connectivity Provider

“I think with satellite it creates a more reliable form of tracking. I don’t think that it’s necessarily cheaper. In fact, some of the things that we’re looking at are very competitive with cellular and adding cellular on actually increases the overall cost.”



President, Satellite IoT Connectivity Provider

“I certainly see high use. I think it’s less about costs. It’s really about the capability of tracking and you can easily outweigh the costs by the benefit it gives. I think the value in satellite connectivity lies exactly when you can use it as an extension to cellular connectivity. Cellular satellite providers should focus on the areas where there is poor cellular cover such as India, Australia, Africa, America. Costs are, at least I would say three to four times higher even for local operators because there is no regulation in place such as in Europe, hence the internal pricing in these areas is so high, the prices will never get as low as in Europe.”



VP, Commercial IoT Applications Provider



Question 7. How do Asset Tracking solutions improve supply chain visibility and efficiency?

Asset tracking can provide valuable data on the location and condition of a shipment, particularly if it travels over a long distance. The data also can be used to recover stolen assets. One solutions provider uses mesh networking to simplify the tracking of a stack of assets.

“ Consider what the container is carrying, €100,000 or \$100,000 worth of goods inside. So it's super important that people get that information, and also for the overall operations of the containers themselves. Theft control with effective tracking systems is a very good case where tracking has been implemented as you see every detail within the supply chain.

If you don't track that across the supply chain on a continuous basis, you cannot have reliable information whether what is shipped has been handled in safe way across the supply chain. Therefore condition monitoring is important.

When the containers are stacked the one at the bottom does not communicate, so you lose track of that container. What we do is that we, by meshing all of these devices together, enable very reliable communication and very low power communication so that all the devices don't have to communicate directly to the Internet, but actually get aggregated whenever there is one of them that is connected to the Internet; that kind of eases and provides better reliability in terms of how things are handled. It's simpler and a lot more efficient. **”**



SVP, Smart Tracking Mesh Networking Provider



Question 8. How are IoT data analytics being used to provide insights from Asset Tracking data?

Data from tracking can be integrated into existing business processes to improve services and improve planning. AI has been mentioned to help here.

Correct information on estimated time of arrival of cargo enhances customer satisfaction and trust.

Additional data on parameters like condition of cargo fuel consumption, best routing options, logistical things, where to route vehicles or cargo also serves to optimise efficiencies. One supplier cites geofencing to ensure cargo does not move outside the permitted area.

“I think there’s a lot of ways to integrate that data into existing business processes and just improve service and reliability. I think there’s just a lot of examples like that where it’s giving you more discrete information that could benefit both the supply side and the customer side.”



IoT Expert, B2B Connected Product & Services

“If you have a constellation of satellites, you can send data more frequently than once a day which generate analytics and insights because of the way the earth rotates.”



Senior Executive, Low Power IoT Connectivity Provider

“The main thing is the location. But what is done based on this data, it’s really nicely actually monetized that, you can bring out estimated time of arrival, customer satisfaction that, you know, it left the warehouse, it will be with you in so much, based on this speed or this transit, it’s with you whatever next week... When you have the last location, and you can make some decisions based on that.”



Regional Sales Director, Cellular IoT Supplier

“We offer geofencing. It means that the customer can monitor every time when the SIM card is located, when the SIM card is moving. Also, he can monitor the history when the SIM card was logged into the network. Then, the customer can also create his own intelligence.”



Regional Sales Manager, IoT Module Maker

“I think there’s a lot of focus on the data, and I think AI’s going to really add to that. So the asset trackers are providing the data that’s necessary for better planning. AI can take that data and then use the data for useful planning.”



President, Satellite IoT Connectivity Provider



Question 9. What ROI can be expected from Asset Tracking systems?

Suppliers have to consider the total cost of setting up a solution, including existing infrastructure, in addition to the cost of deployment. Risk of loss or theft of vehicles must be factored in.

As these matters are sorted out, payback will be shorter and there will be more viable businesses cases and more business.

“Some of them (Roi’s) are really fast, but the challenge has been how much infrastructure cost is there to get it set up. Once technology evolves and gets more robust and reliable, I think some of the Roi’s will be very fast.”



IoT Expert, B2B Connected Product & Services

“We’re looking at paybacks of less than six months, but it is dependent from project to project.”



President, Satellite IoT Connectivity Provider

Question 10. What trends are you seeing with Asset Tracking systems?

Our interviewees saw growing interest in tracking solutions. Apart from commercial cargo, new markets include valuable pets and parcel tracking.

Customers want to extend their business value creation beyond initial requirements. More business cases and opportunities are emerging as new technologies roll out e.g. Bluetooth and Wi-Fi with their new features. As accuracy improves, then more business cases become feasible.

Solutions are getting more complicated as assets move through different forms of transportation and geographic areas with multiple scenarios; both suppliers and customers would like a single end to end tracking offering.

The market is very cyclic – as the market evolves, requirements will change and trends will change.

“You’re moving your assets through different geographic locations and meteorological environments and they cause dynamics and problems that require a single solution. Businesses, too, prefer a single (end-to-end) solution.”



Senior Executive, Low Power IoT Connectivity Provider

“There’s value in tracking but people need to get their business cases right first. To date, I think not every business case has been justified with POC’s, which obviously leads them to project failures.”



President, Satellite IoT Connectivity Provider

“While the focus is on asset tracking solutions, axillary or additional sensors will be added so that you’re not only tracking the location but you’re maybe tracking something else also like air pollution.”




Regional Sales Director, Cellular IoT Solutions



Demand for types of application is very regional. For example, healthcare applications are more in demand in developed countries. For construction projects these are expanding in Asia and the Middle East.



“It’s about cost saving and that changes all the time with different requirements from the market at different times.”

 SVP, Smart Tracking Mesh Networking Provider

“The accuracy is going to get so much better, and the cost effectiveness just keeps getting better so it can creep into more and more applications.”

 IoT Expert, B2B Connected Product & Services

Question 11. What particular application areas are in high demand for Asset Tracking solutions?

Our interviewees identified a growing awareness of the need for security. However there is wide range of opinions on this topic.


Different data has different value – some use cases present a bigger security risk than others. As more data is transmitted, this opens up more risks. Whilst securities for security layers are present in the technology utilised, it is up to the solutions provider to really apply them to the right use case and the right architecture. In many cases, it is easy to neglect to address these issues in the detail required.

It is also important to note that solution providers need to be aware that assets that move across borders will be subject to changing regulatory regimes.


With healthcare, privacy is important – an asset attached to a person could become a proxy for people tracking.

Interviewees highlighted a growing threat from hackers originating from hostile countries. Nonetheless, IT implementations are becoming more secure – the trend here being built-in security by default.


“The security layers are there in technology but it’s up to the integrator or the solutions provider to really apply them to the right use case and the right architecture; as new use cases come up, now we have an inexpensive solution to this problem; however it’s easy to overlook something, here’s an unintended consequence of that that we should have done a little more risk analysis and risk mitigation.”

 IoT Expert, B2B Connected Product & Services

“When goods move from one location to another, they’re moving from one regulatory regime to another. hence some of the problems are around the fragmentation and inconsistency in regulation between different jurisdictions. I think it will be solved with time. Various parties are trying to get some coordination going but right now it’s a problem, which probably will get resolved as we move forward.”

 President, Satellite IoT Connectivity Provider

“Data should be secured, especially these days as there are a lot of hackers that are coming from also from some countries which are maybe not positive ..They want to disturb the economy of some countries. Sometimes they are also subsidized by their governments.”

 Regional Sales Manager, IoT Module Maker



Interview Conclusions

Tracking and tracing applications using Machine to Machine then Internet of Things connectivity have been available for decades. Over time these have become richer, offering additional functionality and support for wider tracking applications, from local fleet management to cross continental journeys.

Traditional, localised fleet tracking applications still help in optimising fuel usage, assuring driving standards safety, as well as making insurance plans fairer, based on real data not just the age of the driver. Now, long distance tracking cargo movement by sea, land and air transport is developing in several ways:

Increasing Possibilities

- More connectivity options – Cellular, LPWAN and Satellite technologies
- New business models – e.g. Tracking as a Service
- The capabilities of IoT devices continue to advance rapidly: there are now more asset tracking devices than ever before in a greater variety of formats

More Challenges

- Growing cargo thefts and loss of assets in transit
- Dealing with regulatory requirements in different countries, e.g. limitations on roaming, device use
- A greater awareness of security - more devices and complicated software solutions can provide malicious attackers with more points of entry



Crossing continents which are composed of several countries creates an ecosystem of contracts, billing and usage systems, ordering, provisioning, and activating multiple SIM cards. Providing reliable mobile connectivity across diverse and sometimes remote areas necessitates a multifaceted approach by solution providers, combining existing cellular networks with satellite communication to ensure consistent and wide-reaching coverage. Doing business across continents requires dispatchers to understand the rules and regulations in each jurisdiction where their IoT devices will be deployed.

The most important requirement for asset tracking solutions is to provide visibility of the assets that are being transported at all times where they are moving – i.e. traceability; predictability, to know what time they are likely to arrive at their destination. In addition to location coordinates, other data on the condition of the asset/cargo may be collected, depending on the application: e.g. temperature, humidity.

In summary, analysing the data gathered from tracking applications helps users to:

- Efficiently allocate fleet resources and deliver orders faster, improving customer satisfaction
- Control the entire delivery service, reducing mistakes by dispatchers and other staff
- Predictive maintenance of the fleet, to keep track of elements that need to be changed before breakdowns occur, saving costs and downtime
- Integrate with other systems, e.g. condition monitoring, cold chain monitoring (pharmaceutical items, fresh food).

Greater Variety of Applications

There are both outdoor and indoor tracking solutions. Indoor asset tracking is used on production lines, manufacturing facilities and warehouses. Common technologies used here include Bluetooth and Wi-Fi networks due to their low cost and high optimisation and accuracy over small distances.

Manual tracking with RFID tags and sensors can track items through different stages of production and warehousing. Some asset makers send usage data back to the supplier.

Precision agriculture is a growing application of outdoor tracking, particularly involving farm vehicles and livestock. Both are major items and subject to increasing theft.

Other applications include the tracking of valuable items – vehicles themselves, high value parcels, hospital equipment – beds, trolleys. Tracking personnel working in hazardous places entails providing an alarm generating device to call for assistance. Remote monitoring of patients outside of the hospital may be used to send back clinical data, and also provide proof of compliance to requirements and regulations.

Finally, consumer applications are growing as tracking technologies improve; these include tracking much loved pets and personal possessions.



IoT Application Requirements for Asset Tracking

This section explores key technologies and sponsor technical insights related to asset tracking solutions.

Asset Tracking Expands Worldwide

Asset tracking is about having round-the-clock knowledge of the location of a business' physical assets. It has evolved far beyond its primary purpose of location monitoring; businesses and customers are increasingly interested in tracking status parameters such as temperature, biometrics, vibrations or humidity, enabling manufacturers to provide solutions of greater value.

Multi-modal containers can be tracked not only to identify their location within a journey but to detect unexpected events like door openings (and therefore detect and protect against theft) or monitor temperature (to limit goods spoilage). Similarly, if monitoring workers, collecting data on their movements can improve their safety.

A greater range of device formats are now available, with miniaturised wearables facilitating convenient people or animal tracking. In addition, slim label-format or credit card sized devices enabling the tracking of individual packages or pallets

and ultra-rugged or resilient devices supporting applications in harsher environments.

Asset tracking applications have grown from local and regional projects to crossing continents, by tracking shipments and railway journeys worldwide with their cargo. The ability to track assets anywhere and everywhere on earth is made possible through increasingly sophisticated communication technologies. With indoor and outdoor options and satellite providing coverage in areas that terrestrial networks cannot, the options for asset tracking have never been so great.

IoT is an essential component to providing asset tracking solutions. It is also proving a valuable tool to combatting increasing cargo theft. Cargo theft surged to alarming levels in 2023 and 2024; nearly \$130 million worth of goods was stolen globally in 2023, but since reporting cargo theft is not mandatory, the amount is likely higher than this, according to CargoNet.

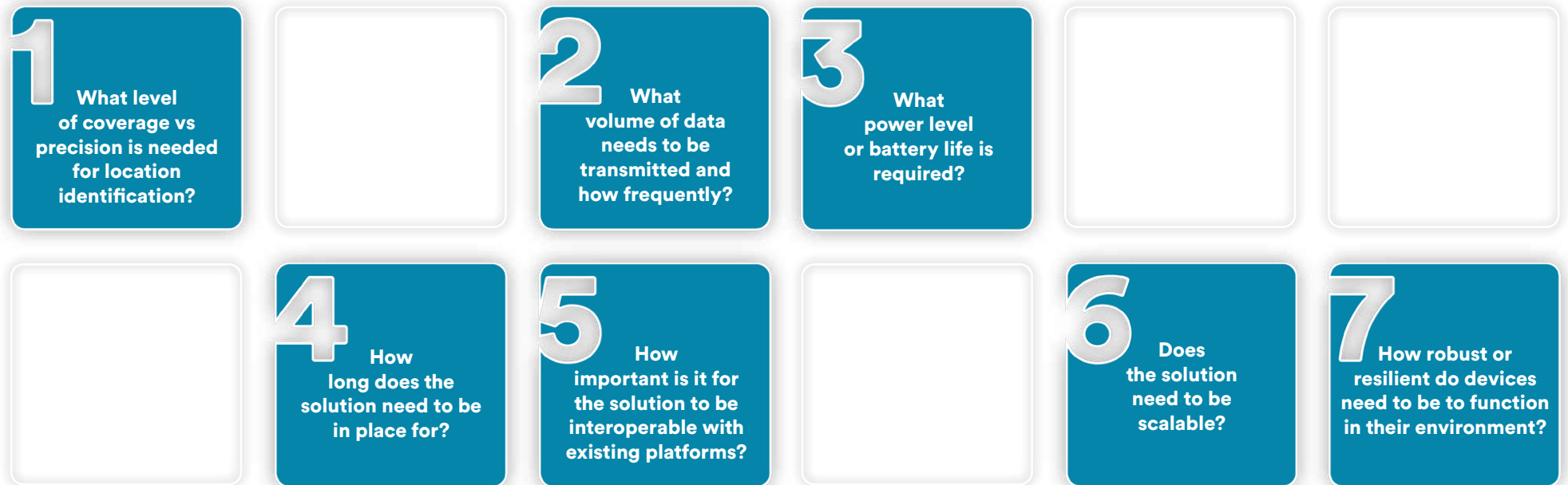
Implementation issues

Choosing appropriate hardware, connectivity technologies and software is vital to a tracking project's success. However, there is no one-size-fits-all solution.

For instance, tracking equipment across a single site has significantly different requirements to tracking equipment roaming between multiple locations – and that is

without considering the data requirements, device density and project budget as well as the nuances of the different environments and assets.

Nevertheless, key questions to keep in mind are:



Finally, tracking solutions must consider regulations in parts of the world where the tracked item may travel; is there a time limit? Is there an additional cost for transmitting data back to the dispatcher's base?

Communication Technologies

Communication technology is a vital component to tracking. The range, data capabilities and power usage of the solution will all be defined by the selected technology.

See Beecham's report [IoT Anywhere: Wireless Data Wherever You Need It](#) for a more detailed explanation of the different types of communication technologies.



Cellular

As the sunset of 2G and 3G continues – at different rates in different parts of the world - the cellular IoT market continues to move towards 4G and 5G. Both 4G and 5G have high bandwidth and low bandwidth options for their applications - NB-IoT and LTE-M (also known as Cat-M) being low bandwidth 4G options, and RedCap a lower bandwidth 5G option. The latter does however offer greater speeds and a higher peak data rate than NB-IoT and LTE-M. Meanwhile, 2G will sunset later than 3G, continuing to provide an ultra-low bandwidth option for ultra-low-data, cost-sensitive applications.

Since all types of cellular IoT devices use existing networks for a connection, no further infrastructure work is required. This makes the setup of such devices for asset tracking convenient and cost-effective. In addition, roaming is a well-established practice in cellular, though certain regions do have bans on permanent roaming and a more localised agreement may need to be agreed with an MNO.

As the dominant technology in mobile phones and wearables, 4G and 5G are prominent technologies in people and pet

tracking. Such devices have greater power consumption than most asset tracking devices and therefore need frequent charging. For long-term tracking of fleets, warehouse inventory or outdoor equipment, NB-IoT and LTE-M are more commonly used, whilst 5G RedCap is more likely to be used in Industrial IoT asset tracking applications. Thanks to its ability to connect indoor and outdoor as well as its higher peak data rates, 5G RedCap supports additional data collection that can be used for condition monitoring or predictive maintenance as well as location tracking.

For businesses with data privacy concerns, there is the option to set up private networks. For those with greater range needs, public and community networks can be used for coverage.

Asset tracking software processes the data received from IoT devices. A user interface enables users to monitor the location of the asset as well as create report, and make use of analytics.



eSIM and iSIM

An increasing proportion of cellular IoT devices now use eSIM (embedded into the device) or iSIM (integrated into the chip) over the standard SIM card. These types of SIM are much more adaptable than the standard SIM as they support remote activation and updates; moreover they are much smaller and therefore facilitate the design of smaller sized devices, and through multi-SIM options enable seamless network switching.

These benefits are leading to significant adoption of eSIM in asset tracking. In [Figure 3.18](#), Logistics/Asset Tracking was deemed the most important use case for eSIM use, with 27% of all respondents choosing this option. (Automotive was ranked second at 20%, followed by Smart Metering with 14%)



LoRaWAN

By facilitating the transmission of small data packets in an energy - and cost-efficient way, LoRaWAN has many qualities making it suitable for low-bandwidth, low-power asset tracking solutions. In rural areas it can connect devices up to 30 miles apart, whilst maintaining the ability to penetrate metals, concrete, glass and other hard materials. As such, when combined with the ultra-rugged design of many LoRa-compatible devices, it is highly suited to monitoring assets in shipping containers, warehouses as well as those in interference-heavy industrial or construction environments.

In addition, a significant number of parts of the world now have roaming-capable LoRaWAN networks. Furthermore, the options

of LoRa-enabled satellite and peer-to-peer connectivity are expanding the scope for LoRa-based asset tracking in ever more remote locations.

And so to the moon! In 2021, a new distance record of 730,360 km was achieved with LoRaWAN technology. For the first time a LoRaWAN message was sent to the Moon and successfully demodulated after bouncing. Modulation and demodulation used the latest LR1110 transceiver chip from Semtech, and the Dwingeloo radio telescope was used as the antenna. Analysts hint that this technology could be used in future moon missions to track autonomous vehicles as they move across the lunar surface.

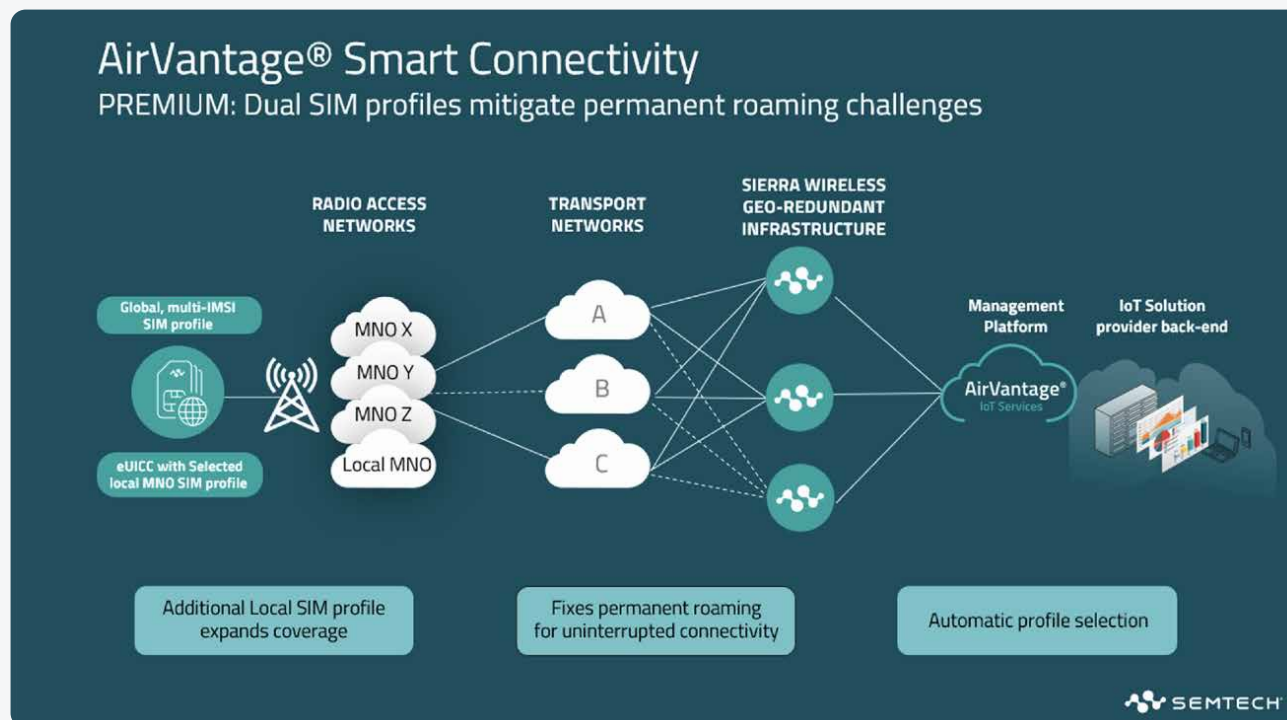


AirVantage® Smart Connectivity with Multi-IMSI, Multi-Profile, Universal Coverage Capabilities

Semtech’s AirVantage Smart Connectivity offers a resilient global connectivity service with one SIM, one platform and one IoT solutions provider. Smart Connectivity has access to over 600 partner networks in over 190 countries and territories, all with a single global SIM. The Smart Connectivity SIM features multiple International Mobile Subscriber Identities (multi-IMSI) and a proprietary applet that enables it to connect voice and data services to one of many operator networks available at a location. Upon activation, the Smart Connectivity SIM works with the connected device to scan for all available networks and connect to the one of highest quality. The applet intelligence offers extra resilience as it automatically switches to alternative networks when a network disruption is detected, providing always on connectivity to assets.

Smart Connectivity simplifies global logistics, allowing organizations to deploy a single SIM SKU connecting their products across global markets, removing the unnecessary step of negotiating and managing contracts and relationships with multiple operators.

Smart Connectivity Premium offers a second layer of resiliency by combining the Smart Connectivity Advanced multi IMSI offer with an additional local MNO profile, both eUICC enabled. Smart Connectivity Premium allows customers to overcome permanent roaming challenges by using one global SIM which automatically downloads the necessary profile in hard geographies.





Short-Range Technologies

Tracking assets on-site is also a valuable business need, especially on large sites. The ability to swiftly identify the location and status of an asset can vastly improve operations and even be lifesaving in case of some healthcare applications or more risky workplace environments.

Wi-Fi can transmit significant packets of data with low-latency and is therefore useful for higher-capacity, time-critical applications.

Bluetooth and BLE have a shorter range than Wi-Fi but offer a notably high degree of location precision. These technologies are compatible with existing IT infrastructure but have little resilience to metallic or reflective interference. In the case of BLE, devices transmit smaller data packets with high energy-efficiency, making this a more affordable option.

Ultra-wide band (UWB) is another high-precision technology with energy efficiency. It offers good resilience against interference and can send significant amounts of data across short distances. However, implementation costs are typically higher.

It is worth noting that the range of these technologies can be extended via the use of a mesh network. With each device acting as sensor, transmitter and receiver of data, information can be passed through the web of devices, enabling them all to communicate with each other without the use of a gateway. In addition, if a signal is disrupted in one area of the network, a new path of transmission can be found, making this system very robust and scalable.



Satellite M2M/IoT

Terrestrial networks are estimated to cover around only 20% of the Earth's surface. As such, satellite based solutions are being implemented to reach the areas that terrestrial networks cannot service, such as oceanic and remote land areas.

Technological advancements in IoT devices have made new use cases for satellite IoT emerge at an unprecedented rate.

Satellite connectivity is proving useful for applications in agriculture, asset tracking, maritime and intermodal transportation, oil and gas industry exploration, utilities and construction among others.

There are three types of satellite, characterised by orbital height above the equator:

- **LEO satellites** = low earth orbit satellites.
- **MEO satellites** = medium earth orbit satellites
- **GEO satellites** = geostationary satellites

The three types are suited to different use cases, coverage needs and data transmission schedules.

HAPS, standing for High Altitude Pseudo Satellites or High Altitude Platform Systems, are positioned in the earth's stratosphere. Typically unmanned aircrafts or balloons, they offer additional complementary applications to satellites and terrestrial connectivity networks.

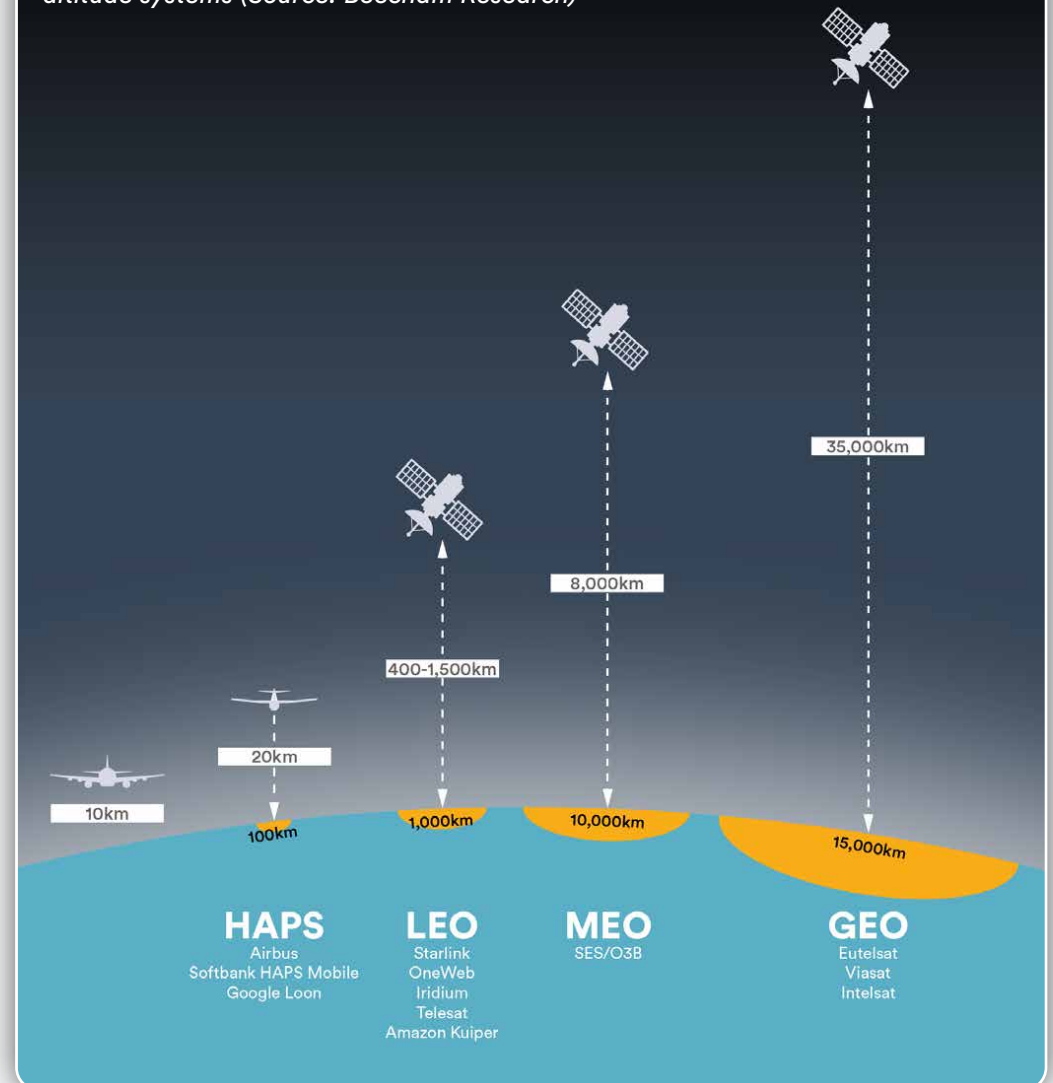
LEO operators can extend coverage of their constellation by increasing the number of ground stations so that there are more locations able to receive satellite data, or by vastly increasing the number of satellites in orbit.

When tracking mobile assets, shippers either need a device that auto-points itself at a satellite in geostationary orbit, or use a device that connects with satellite constellations in low earth orbit.

Hybrid satellite-terrestrial networks (HSTN) are seeing increasing demand as businesses seek to fill connectivity gaps in their IoT solutions. 3GPP Release 17 included specification on how satellite integration with NB-IoT and LTE-M could expand 5G coverage.

There is also an increasing number of LoRaWAN® compatible satellites available. Further integration of satellite and terrestrial technologies is anticipated in order to build communication structures that address the connectivity challenges that evolving use cases present.

Figure 4.2. Typical altitudes and footprints of existing satellite and high altitude systems (Source: Beecham Research)





Space-based Personal Tracking

EchoStar Mobile is an agile, innovative satellite operator providing organisations with better value, productivity and operational safety via its market-disruptive approach to connectivity solutions. With a converged satellite and terrestrial network covering the whole of Europe, the company connects millions of fixed and mobile assets.

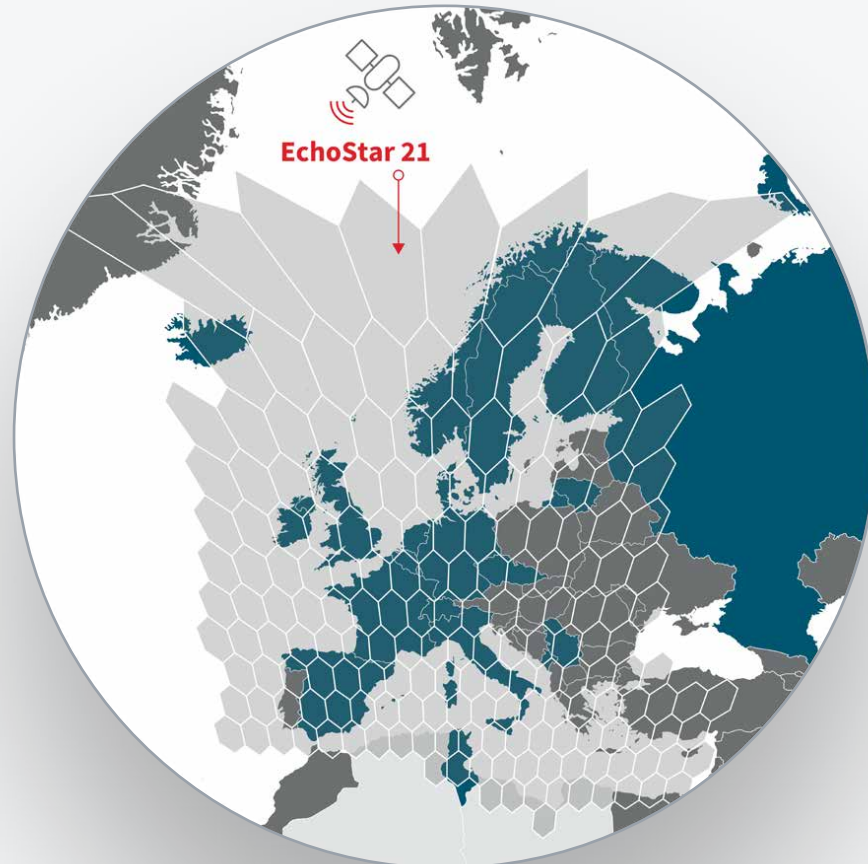
EchoStar 21

EchoStar E21 is a powerful GEO satellite with an 18-metre antenna operating in the S-band. It features advanced beamforming technology that provides high-quality service in focused geographic areas.

Combining powerful S-band payload with high beam power means a very strong signal is received on the ground. In addition, because of the sensitivity of the LoRa® technology, the network achieves excellent performance with very small antennas. The very high sensitivity of LoRa® means the EchoStar Mobile solution can receive signals in conditions where even other satellite services would struggle to work.

Further benefits are gained from the use of Long-Range Frequency Hopping Spread Spectrum [LR-FHSS] in the licensed S-Band. Developed by Semtech, LR-FHSS allows direct-to-satellite data links from IoT devices with greater reliability, higher performance and lower power consumption. The use of LR-FHSS provides several advantages, including enhanced data rates, increased network capacity and additional robustness to interference, allowing new deployment opportunities.

EchoStar Mobile operates the first and only European-wide satellite LoRa®-enabled IoT network, providing direct-to-satellite connectivity to and from battery-operated IoT devices and enabling real-time bi-directional communication without requiring additional infrastructure, so that assets can be seamlessly monitored and managed across Europe





Stay Connected, Stay Safe When Going Off-Grid

Going out into isolated locations is always a risk. If you experience an issue, getting help is often not straightforward, with limited or non-existent coverage for communication networks. Whether you're scaling remote mountain ranges or sailing the waters off the European coastline in the pursuit of adrenaline, or you're a lone worker servicing critical infrastructure in the middle of nowhere, in these remote locations conventional means of communication typically falter. Cell towers become non-existent, and the safety net they provide disappears, leaving you vulnerable should an emergency occur, with no way to call for help. This 'off-grid' reality becomes more than just an inconvenience but a genuine risk.

A communication device that can bridge the connectivity gap where terrestrial networks don't reach is the key. It's not just about staying reliably connected; it's about ensuring safety in isolated and challenging environments. In this context, the value of a satellite-enabled tracking device becomes clear.

While dedicated satellite phones have been around for some time, they are known for being expensive. Meanwhile, there is emerging technology for SOS capability via satellite on the latest smartphone models, but again, price could be a concern. So, there remains a need for an affordable, accessible solution for individuals seeking safety when venturing out of traditional network range.

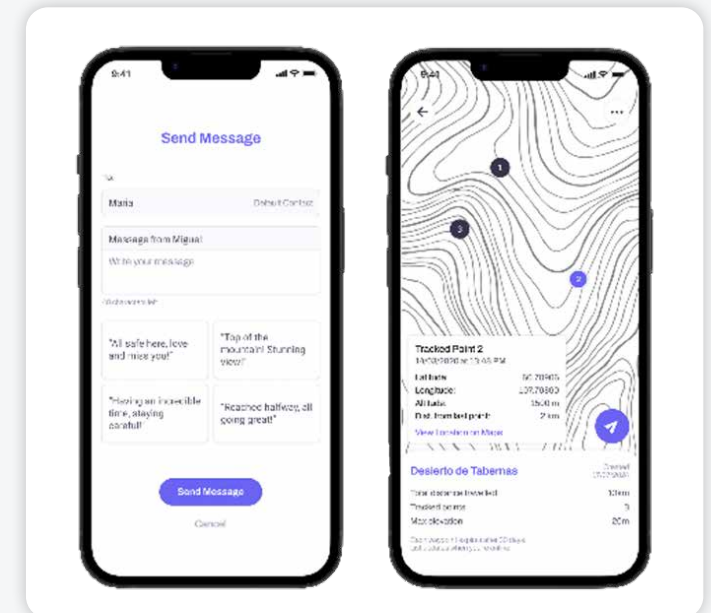
A Personal Safety & Tracking (PS&T) device integrating EchoStar Mobile's EM2050 module and operating over EchoStar Mobile's LoRaWAN®-Enabled Satellite IoT Network provides ubiquitous and reliable connectivity across Europe with no

roaming required and zero service gaps. Individuals can use personal trackers while going off-grid so that their location can be identified by friends, families and, in case of emergencies, search and rescue teams.

EchoStar Mobile's satellite network operates over licensed S-band as a private, dedicated spectrum, thus ensuring interference-free, secure connectivity. Moreover, the S-band spectrum is highly resistant to signal fading caused by rain, snow or ice, meaning no matter what weather is faced, resilient communications are assured.

A PS&T device that can be managed through a smartphone app, providing reliable connectivity in even the most remote locations at an affordable price will:

1. Allow you to trigger an immediate distress signal to pre-allocated emergency contact with just the single press of a button.
2. Connect to your smartphone via Bluetooth and, acting as a relay, send custom messages via satellite to the recipient smartphone as a standard SMS, even when cellular networks are unavailable.
3. Track your journey through an interactive map, recording your location, which can be shared with others.



Location Technologies

Location technology comprises tools and systems designed to pinpoint and track the geographical position of objects or people. They include:



Global Positioning System (GPS): GPS relies on satellite signals to detect precise geographic coordinates. GPS mapping software translates signals from satellites orbiting the Earth into navigable maps, providing users with precise and real-time geographic coordinates. By combining signals from multiple satellites, GPS mapping software determines the exact position of a device or asset, offering accurate outdoor navigation capabilities.



Cellular technology enables location tracking through mobile networks, relying on cell tower triangulation. Mobile devices use sensor data (from NFC, Bluetooth and Wi-Fi) to refine location information.



Bluetooth technology enables accurate indoor positioning by using low-energy beacons.



Wi-Fi Location Positioning leverages wireless networks to determine the location of devices within an infrastructure.



Radio-frequency identification (RFID) involves tags and readers to identify and track objects wirelessly over short distances



The Manta Fusion Indoor/Outdoor Tracking Device

The Manta Fusion is the latest addition to Digital Matter's range of battery-powered GPS tracking devices, designed for seamless indoor and outdoor asset tracking and management.

Driven by continuous innovation and the evolution of their existing hardware solutions, the Manta Fusion is designed to offer exceptional performance and accuracy across a wide range of use cases. It supports multiple location technologies, including full GNSS, Wi-Fi Scanning for indoor location, Cell Tower fallback, and Bluetooth Low Energy. This versatility makes the Manta Fusion ideal for various applications, such as supply chain visibility and logistics, high-value pallet and cargo tracking, containers, packaging, returnables tracking, and hospital equipment management, among others.

The Manta Fusion connects to global LTE-M (Cat-M1) and NB-IoT networks, integrating advanced location technologies from Sony Semiconductor and Semtech for precise asset tracking. It seamlessly switches between location methods as assets transition between indoor and outdoor environments, ensuring the most accurate location data possible.

Engineered for ultra-low power consumption, the Manta Fusion can operate for up to 10 years on three AA user-replaceable batteries. This reduces deployment and operational costs by leveraging modem platform capabilities together with our firmware and other design features to minimize the need for frequent battery changes.

Additionally, the Manta Fusion functions as a Bluetooth Gateway, with optional capabilities to scan third-party

Bluetooth sensors to capture condition data such as temperature, humidity, movement, and more.

The Manta Fusion's ultra-rugged, low-profile design makes it suitable for tracking a wide variety of assets, and the use of a small magnet for device activation enables faster device provisioning and deployments at scale. The magnet can also be used for tamper detection.

All Digital Matter tracking hardware can be managed remotely via Device Manager. This cloud-based platform simplifies device integration, updates, and configuration, saving time and resources while maximizing device performance through over-the-air updates.



Location Aware Applications

Fleet management: By processing data related to location, motion, temperature, speed and fuel consumption, logistics companies can compute the safest and most fuel-efficient for their vehicles and provide better customer service. Sensor data can measure wear and tear; by alerting fleet managers to any issues before they become crises, fleet owners can lower costs and improve driver safety, as well as avoiding costly and reputation damaging delays.

Autonomous driver assistance: Autonomous driverless vehicles – self driving cars – are equipped with technology that senses the conditions around it, including traffic, pedestrians, and physical hazards and can adjust its course and speed without a human at the controls. Autonomous vehicles make best use of IoT enabled tracking technologies. Applications include:

- Vehicle-to-Vehicle (V2V) communications
- Vehicle-to-Everything (V2X) communications.
- Driver safety, e.g., detecting driver distraction and signs of drowsiness.

Much work is ongoing regarding driving safety issues without a human at the controls.

Cold chain: In addition to theft, there is a growing problem with food spoilage; a third of all food produced globally is wasted, largely due to temperature changes. By measuring the condition of perishable food items or pharmaceuticals that must be kept refrigerated, and being able to act on an unexpected temperature change in a refrigerated unit, shippers can reduce the chances of spoiled goods on arrival.

Lone worker/driver monitoring: Lone workers in isolated or potentially unsafe areas carry wirelessly connected safety devices which they can use to summon help if needed. By giving drivers of vehicles containing cargo a means of contact with the outside world, even when out of mobile phone range, shippers can improve their personal safety while giving reassurance that the goods will be delivered on time.

Navigation Apps: These provide real-time directions and traffic updates, guiding drivers with turn-by-turn navigation, suggesting optimal routes based on current traffic conditions.

In warehouses and logistics centres, a similar technology ensures efficient movement of assets and personnel, optimising operations as a whole.

Healthcare: Location-aware applications assist in patient tracking within hospitals, optimising workflows and enhancing overall patient care. The technology also assists in locating mobile medical equipment swiftly, improving overall operational efficiency.

Retail: indoor mapping transforms the customer experience in a shopping mall. Retailers can provide interactive maps helping customers easily locate products and navigate the space. This improves customer satisfaction and also streamlines in-store operations, optimising shelf stocking and inventory management.

Motor Insurance: The data generated from devices in vehicles can assist insurers to analyse customers' data and identify the cause of an accident, driver behaviour and guide risk assessment. IoT data can reduce fraud on an insurance claim.

SONY

How to build a Tracker device with a single chip platform solution

Introduction

The ALT1350 is a cutting-edge single chip tracker platform that offers a wide range of capabilities for various tracking applications. We'll review here how the ALT1350 embeds in a single chip design, the fundamental requirement for many tracker types, such as multi-tier location capabilities, multi-connectivity with NTN, ultra-low power modem, integrated GNSS, WiFi sniffing, miniature design, and powerful MCU with sensor hub integration. The ALT1350 leverages Sony's OneSKU™ technology which enables worldwide operation regardless of the region, for simpler inventory management and deployment.

Multi-Tier Location Capabilities

The ALT1350 is designed to fit any type of tracker, offering versatile multi-tier location capabilities.

For precise location tracking requirements, the ALT1350 integrates GNSS (Global Navigation Satellite System) technology from Sony, providing accuracy within 1-5 meters. This makes it ideal for applications that demand high precision, with intermittent location reporting.

ALT1350 also supports external GNSS modules design for concurrent operation. This flexibility allows for optimized power consumption, as the tracker can intelligently exploit both internal and external GNSS options based on the availability of signals and power requirements.

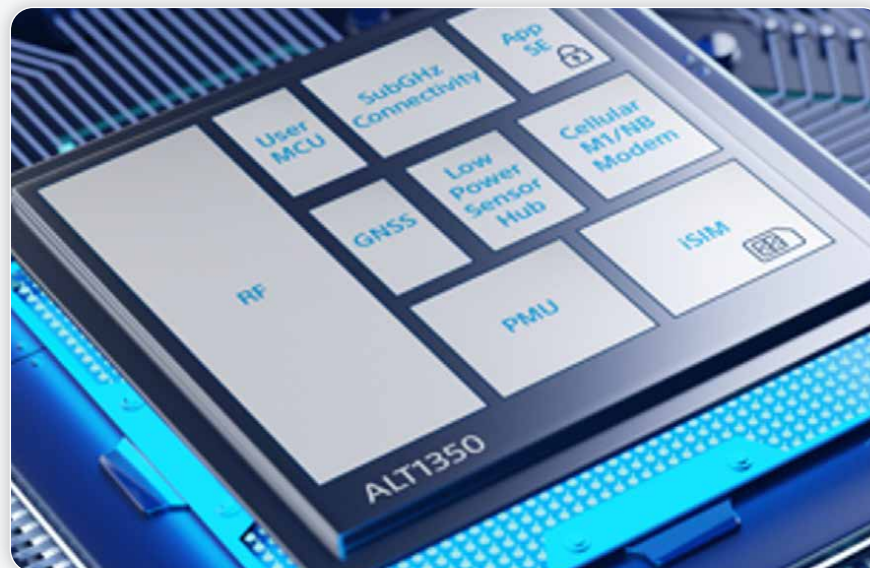
For more relaxed location requirements, the ALT1350 utilizes Cell ID technology for approximate location tracking with an accuracy of 50-100 meters, suitable for applications that require general location information.

Multi-connectivity with NTN

Non-Terrestrial Networks (NTN) technology revolutionizes asset tracking by providing seamless, global connectivity, even in the most remote and challenging environments where traditional terrestrial networks fall short.

By integrating NTN with LTE-M technology, ALT1350 offers multi-connectivity designs for devices, enabling asset trackers to achieve unparalleled reliability and coverage.

This synergy of NTN and LTE-M empowers businesses with robust, versatile, and cost-effective tracking solutions that are resilient to network limitations.

**Altair**



Ultra-Low Power Modem

The ALT1350 features an ultra-low power modem, setting new bar in cellular IoT based devices and ensuring ultra long battery life for tracking devices.

By optimizing power consumption, designed from the ground up, the ALT1350 extends the operational lifespan of trackers, reducing the need for frequent battery replacements or recharging.

This energy-efficient design makes it suitable for applications that require long-term tracking without compromising on performance.

WiFi Sniffing for Indoor Location Finding

As many trackers are designed to support holistic use cases, they often require acquiring location not only outdoors, tracking the packages, but also indoor to identify when a parcel reached a certain warehouse.

In addition to the comprehensive outdoor location tracking capabilities, the ALT1350 incorporates WiFi sniffing technology, enabling indoor location finding capabilities.

By leveraging existing WiFi networks, the tracker can determine its position within indoor environments where GNSS signals may be limited or unavailable.

This feature is particularly useful for applications requiring consistent tracking, such as asset tracking in warehouses or indoor navigation in large facilities.

Integrated SIM and Powerful Low Power MCU with Sensor Hub
The ALT1350 integrates a SIM card (iSIM), eliminating the need for external SIM modules, enabling out of the box connectivity and simplifying the tracker's design.

It also incorporates a powerful low power MCU (Microcontroller Unit) with a sensor hub, enabling seamless integration with various sensors and peripherals.

This combination of integrated SIM and MCU with sensor hub provides a comprehensive solution for collecting and processing data from connected sensors, enhancing the functionality and versatility of the tracker.

Miniature Design for Tiny Devices

The ALT1350 enables a miniature module design, making it suitable for integration into small, space constrained tracker devices.

Its compact size allows for seamless integration into various form factors without compromising on performance or functionality.

This feature is particularly advantageous for applications that require discreet tracking or wearable devices with location capabilities.

Conclusion

The ALT1350 stands out as a single chip tracker platform with its multi-tier location capabilities, multi-connectivity with NTN, ultra-low power modem, integrated GNSS, WiFi sniffing, miniature design, and powerful MCU with sensor hub integration make it a versatile and efficient solution for a wide range of tracking applications. Whether it's asset tracking, personal navigation, or comprehensive indoor/outdoor location finding, the ALT1350 offers reliable and precise tracking capabilities while maximizing battery life and minimizing device size.



The Future of Asset Tracking

Enterprises are increasingly doing business across multiple locations and wide areas. Asset tracking is a necessity for location monitoring, keeping track of inventory and overseeing the condition of a business's assets and their maintenance.

Analysts have identified trends in how asset tracking might develop post-pandemic as global cargo shipping continues to increase.

- The demand for cost effective asset tracking is growing worldwide.
- Improving connectivity – further integration, use of hybrid networks allows businesses a greater choice of connectivity type, to take advantage of different networks available as assets move across ever widening routes.
- The rollout of 5G networks is expected to provide faster data transfer speeds and lower latency, improving asset tracking reliability and faster location readings.
- Edge computing will find more usage. Processing data closer to where it is generated, edge computing reduces the need for data to travel to centralised servers. On the other hand, cloud computing enables data from large scale asset tracking systems to be stored and managed centrally.
- Visibility is important: real time data collection allows businesses to know how and where their assets are held up on their journeys.

- Improvements in device hardware – more ruggedisation, new formats will facilitate more types of asset tracking in harsher locations.
- Satellite tracking – greater precision and increased scope / coverage; LoRaWAN is now a connectivity option to enable more use cases.
- Greater automation and data processing makes for faster responses to location requests.
- Better end to end processing and maintenance e.g. asset lifecycle management
- Enhanced asset analytics, e.g. use of artificial intelligence
- State of the art cybersecurity will be needed as risks increase.

In summary, asset tracking is expected to become more widespread across all parts of the Earth's surface, as well as more efficient and more accurate. It will also become increasingly automated in the future, with the greater adoption of AI and machine learning.

Sponsors' IoT Offerings:

How our sponsors are addressing the challenges in the asset tracking market. Short profiles of our research sponsors and their offerings in the IoT market. For more details, please contact them direct.

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EchoStar Corporation (NASDAQ: SATS) is a global provider of satellite communication solutions. Headquartered in Englewood, Colorado and with business around the globe, EchoStar provides secure communications technologies and services through its Hughes Network Systems, EchoStar Satellite Services and Dish business segments.

EchoStar Mobile, a subsidiary of EchoStar Corporation, has commercial operations headquarters in the UK, a satellite teleport and data centre in Griesheim, Germany, and field offices in the UK, Germany and Italy.

In November 2022, EchoStar Mobile launched a commercial pan-European LoRaWAN®-enabled IoT network. The network, operating in EchoStar Mobile's licensed S-band spectrum from the EchoStar XXI satellite, is the first to offer bidirectional, real-time LoRa®-enabled connectivity across Europe using a single network.

EchoStar Mobile's LoRaWAN®-enabled satellite network facilitates existing IoT applications and solutions to extend their reach. IoT sensors, such as, but not limited to, temperature, humidity, flow, current and GPS tracking devices, send data to an EchoStar Mobile-designed LoRa® core module (EM2050). The module then uses licensed S-band frequencies to transmit the data to EchoStar Mobile's own satellite E21. From there, it is sent to the satellite teleport and, through a LoRaWAN® compatible network infrastructure, is forwarded to the customer endpoint.

Licensed Spectrum

EchoStar Mobile has an exclusive licence to use a portion of the S-band, which is a reserved band that is particularly weather-resistant and, hence, suitable for European climates. The S-band is a frequency band covering 2 to 4 GHz. As a result, the S-band LoRaWAN®-enabled IoT network provides seamless pan-European coverage, providing bi-directional, real-time connectivity to LoRa® sensors across the coverage area with no additional infrastructure required.

The EchoStar E21 satellite can capture data from low-power LoRa® modules across the coverage area. It can receive signals in conditions that would be difficult when using

unlicensed bands. In addition, improvements to the LoRa® protocol allow for enhanced data rates, increased network capacity and additional robustness to interference.

EchoStar Mobile chose to deploy LoRa® and LoRaWAN® technologies as central elements in its network. As well as connecting to the satellite network, the EchoStar Mobile EM2050 module is also able to operate on terrestrial ISM band LoRa networks.

This unique dual-mode capability (see **Figure 5.1**) enables IoT solution developers to use a single technology in their solution design, which can use terrestrial or satellite connectivity as needed without having to undertake an expensive integration with satellite hardware. For example, a vehicle tracking solution could connect to a terrestrial network when the vehicle is in an underground car park; however, when outdoors and no terrestrial service is available, the tracking solution would switch to the satellite network. This ensures reliable and timely transfer of data from sensors or trackers to data processing or control centres.

The GEO Satellite

Orbiting at some 36,000 kilometres above the Earth, GEO satellites have been used for more than 50 years. The major advantage of a GEO satellite is that a single satellite can provide coverage to one third of the Earth, and three GEO satellites can provide services to any location on the Earth except the polar regions. Having a satellite constantly overhead makes GEO satellite-based systems a key enabler of many critical time-based use cases.

EchoStar XXI (E21) is a powerful GEO satellite with an 18-metre antenna operating in the S-band. It features advanced beamforming technology that provides high-quality service in focused geographic areas.



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Combining powerful S-band payload with high beam power means a very strong signal is received on the ground. In addition, because of the sensitivity of the LoRa® technology, the network achieves excellent performance with very small antennas. The very high sensitivity of LoRa® means the EchoStar Mobile solution can receive signals in conditions where even other satellite services would struggle to work.

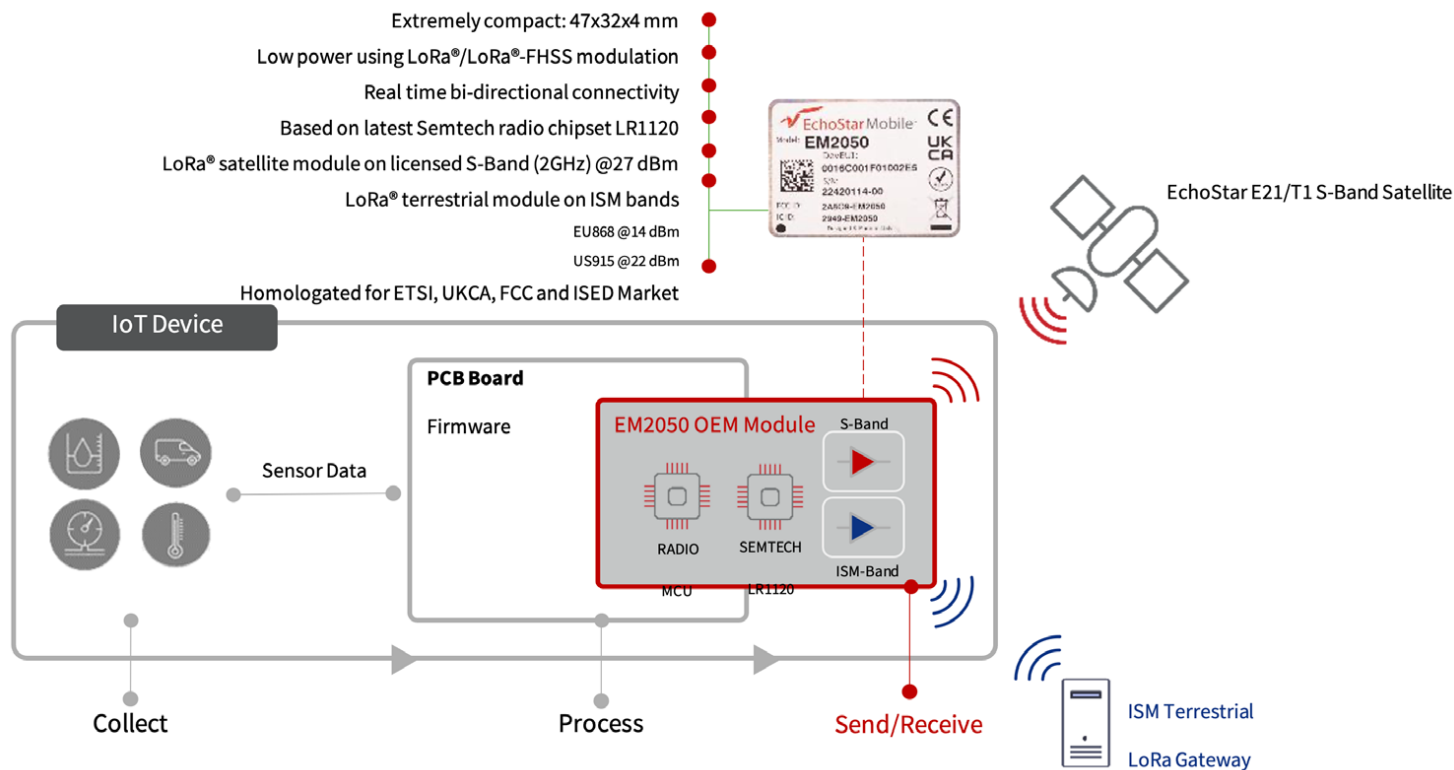
The antenna is also tuned to collect the minimal amount of noise, allowing very efficient reception of the ground signals at the satellite. The combination of a high-power satellite with the characteristics of the LoRa® waveform affords a significant reduction in the size and power consumption of the EM2050 modules. The IoT devices can be battery-powered, requiring no mains power, and their low power consumption means that batteries can last for long periods before needing replacement.

Further benefits are gained from the use of Long-Range Frequency Hopping Spread Spectrum [LR-FHSS] in the licensed S-Band. Developed by Semtech, LR-FHSS allows direct-to-satellite data links from IoT devices with greater reliability, higher performance and lower power consumption. The use of LR-FHSS provides several advantages, including enhanced data rates, increased network capacity and additional robustness to interference, allowing new deployment opportunities.

Customisable Implementations

To allow building a customised solution, EchoStar Mobile has adopted a business model based on Value Added Resellers (VAR): EchoStar Mobile supplies the EM modules and satellite connectivity service to a VAR – that usually is either a system integrator, a solution provider or an IoT device manufacturer, who integrates them into an IoT product or solution. The VAR then markets that product and/or solution to its own end-user customer requirements.

Figure 5.1. Dual Mode Operations



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Digital Matter is a leading global developer and supplier of GPS asset tracking, sensor monitoring, and advanced telematics solutions.

Engineered to outperform, we offer a versatile range of ‘deploy once’ hardware, with the largest portfolio of battery-powered IoT tracking devices across various connectivity and location technologies.

In the past 23 years, we’ve designed and manufactured over three million devices, deployed in 130+ countries. Together with our global channel partners, we help businesses worldwide connect, protect, and derive more value from the assets that matter.

Our Solutions

Digital Matter offer end-to-end IoT asset tracking and sensor monitoring solutions designed to scale with your business. Our unique advantage is the flexibility of our devices and software, allowing for building block customization and application diversity across a wide range of use cases and industries.

GPS Devices: Digital Matter offers a versatile range of high-quality GPS asset tracking, sensor monitoring, and advanced telematics hardware designed to connect, protect, and maximize value from any asset, anywhere. As pioneers in battery-powered IoT asset tracking, we set the standard for innovation, battery life, and performance, with a relentless attention to detail that ensures the highest quality and reliability. Our devices provide comprehensive coverage, integrated Bluetooth gateways, and flexible inputs/outputs for deeper insights and robust asset management.

Device Management: Our device management platform provides remote over-the-air (OTA) control of all Digital Matter devices, offering tools for managing device parameters, firmware updates, and monitoring device health, including debugging capabilities. The platform also includes a location solver and data enrichment engine to optimize device performance and data accuracy.

Data Integration: Digital Matter’s solutions enable secure data transmission to any endpoint, whether integrating with an existing system or developing a new one. The open and flexible payload structure, along with detailed integration documentation and technical support, helps streamline processes and accelerate time to market.

Custom Development: We offer customization of our existing devices for niche applications, including tailored firmware, housing, and sensor integrations, or the development of fully custom solutions. By leveraging our extensive library of device functionality, clients can enhance their designs and deliver added value to their customers.



[WEBSITE](#)

Global Partner Network

Our devices are trusted by some of the world's largest organizations for their reliability and performance. Whether reselling Digital Matter products under your own brand or deploying them across your business's critical assets, partnering with us provides flexible and scalable hardware and software, along with dedicated technical support, to help you deliver world-class IoT systems.

Our Technology

Multiple Location Technologies: We offer a range of location technologies to provide comprehensive asset tracking and visibility solutions for both indoor and outdoor environments. Our devices support GPS for accurate outdoor positioning, Wi-Fi MAC address scanning and Bluetooth scanning for precise indoor tracking, and cell tower positioning for broader coverage, offering versatile options for diverse tracking applications.

Multiple Connectivity Options: We provide a comprehensive range of connectivity options to ensure reliable tracking anywhere in the world. With support for Cellular 4G/5G, LTE-M (Cat-M1)/NB-IoT with network roaming, 4G LTE Cat 1bis with 2G fallback, LoRaWAN® (868, 902-928 MHz), and Iridium and IoT satellite connectivity, our future-proof solutions enable seamless worldwide tracking.

Multiple Power Options: We offer both battery-powered and wired devices, providing flexible solutions for tracking both powered and non-powered assets. With the largest portfolio of battery-powered devices on the market, our products are designed for exceptional longevity and reliability. Low-power consumption is at the core of our design philosophy, ensuring long-lasting performance throughout the life of the asset.

Cloud-Based Location Solving: Unlike most GNSS asset tracking devices that perform location calculations on-device, our Edge device range takes a unique approach by offloading this processing workload to the cloud, achieving 5-10x lower power consumption compared to most other IoT asset management solutions.

This significantly extends battery life and provides ultimate control, allowing users to customize location technologies and adjust reporting settings to optimize performance and meet specific needs.

Bluetooth® Low Energy (BLE): Our range of Bluetooth Gateway devices combine precise GPS tracking with BLE technology to provide comprehensive asset visibility. Easily integrate third-party BLE tags, sensors, or beacons to capture and report critical data, ideal for applications such as inventory management, cold chain monitoring, asset mishandling detection, and vehicle condition reporting.

Remote Sensor Monitoring: Our IoT data logger range, featuring a flexible I/O card architecture, allows for seamless integration with an extensive range of sensors. Remote management capabilities provide easy configuration and updates, supporting scalable deployment across diverse environments. This versatility enables the development of tailored solutions for a wide range of sensor monitoring applications—from environmental monitoring to equipment management—ensuring comprehensive data insights and efficient operations.

Awards & Recognition

Our IoT solutions have garnered significant industry recognition, reflecting our ongoing commitment to innovation and excellence. In 2023, Digital Matter was named Global IoT Innovation Vendor of the Year by the IoT Breakthrough Awards, while the Hawk IoT Data Logger received the IoT Evolution Product of the Year award. Additionally, our Oyster Edge indoor-outdoor GPS tracker with Bluetooth® Gateway received the IoT Evolution Asset Tracking Award, showcasing our leadership in IoT asset tracking and monitoring solutions.

Connect With Us

Visit [our website](#) to explore our diverse portfolio of low-power tracking devices and connect with our team to discuss your upcoming IoT project.



WEBSITE

Semtech Corporation (Nasdaq: SMTC) is a leading provider of high-performance semiconductors, IoT systems, and cloud connectivity services. We are dedicated to delivering innovative technology solutions that foster a smarter, more connected, and sustainable planet.

LoRa® technology inventor and a pioneer in cellular modules and connectivity services, Semtech offers a comprehensive range of cellular- and LoRa-based Low Power Wide Area Network (LPWA) devices and connectivity solutions. We are uniquely positioned to help our customers build asset tracking solutions with the following capabilities:

- Support for dual backhaul connectivity (LoRa or cellular) based on network availability and power constraints
- Support of terrestrial and non-terrestrial connectivity with both cellular and LoRaWAN®-based satellite operators

Technologies and connectivity for ubiquitous asset tracking coverage

Relying on a single technology to track assets can be challenging, especially indoors, outdoors in dense urban environments, or in areas with poor satellite coverage or inconsistent network connectivity. Semtech's IoT solutions and services offer multiple location aware technologies: GNSS scan, passive Wi-Fi access point (AP) scan, Bluetooth Low Energy (BLE) beaconing compatibility¹, and round-trip-time-of-Flight (RTTof). These long and short range technologies work together for versatile and effective indoor and outdoor asset management solutions. Survey results showed that over 90% of respondents viewed a multi-connectivity approach as critical for asset tracking applications. Semtech's technologies address these needs enabling operation via cellular or LoRaWAN public or private networks, whether terrestrial or non-terrestrial networks (NTN).

¹Semtech's products are designed to be used in connection with qualified Bluetooth products and applications but are not certified or qualified Bluetooth® products

Location awareness ICs – LoRa Edge™

Semtech's LoRa Edge is an ultra-low power platform for asset tracking, combining a long-range LoRa transceiver operating in the sub-GHz and 2.4GHz ISM bands and SATCOM S-Band, multi-constellation GNSS scanner, and passive 2.4GHz Wi-Fi MAC address and RSSI scanner.

Long-range connectivity: Worldwide terrestrial and satcom connectivity is achieved thanks to Semtech's third generation LoRa transceiver IP with market leading link budget enabling up to 50% longer range compared to other LoRa chips in the market.

Low-power location tracking: Integrating a GNSS receiver (GPS/BeiDou) and a passive Wi-Fi sniffer, LoRa Edge enables best in class power consumption by offloading the power intensive geolocation position computation to a cloud solver,

Figure 5.3 Mix of terrestrial and satellite LoRa & cellular networks





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enabling lower cost, smaller size, and power efficient end devices that can be powered from tiny batteries or none, thanks to advances in energy harvesting solutions. Its RTToF API allows a LoRa Edge based device to determine its distance from another LoRa Edge device. This can be used to implement a “Find my device” that functions across miles. BLE beaconing, detectable by any BLE receiver such as a smart phone, can further help a “finder” to locate “assets” within Bluetooth range.

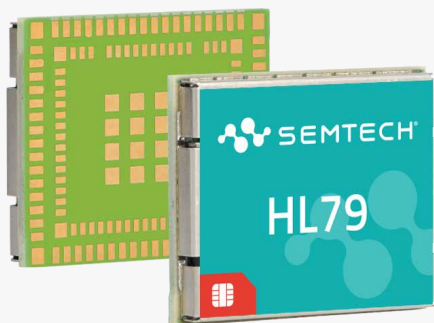
OpEx efficiencies: Offloading the power intensive computation from the end device to the cloud allows trackers to extend battery life as much as 10 years and reduce OpEx by eliminating costly batteries replacements. Cloud applications can offer fine grain power control, adjusting the tracker behavior along its journey and balance performance and TCO for each segment.

Cellular LPWA modules – the HL7 Series

Semtech’s cellular LTE-M and NB-IoT module portfolio, specifically the new HL7900 5G LPWA module based on Sony’s ALT1350 chipset, offers ultra-low power consumption and innovation capabilities for modern asset tracking needs.

Power consumption: HL7900 reduces current consumption by up to 80% compared to previous generation LPWA modules, effectively quadrupling the battery life of tracking devices.

Figure 5.4 HL79 series module



Comprehensive location tracking: HL7900 combines integrated GNSS and Wi-Fi-based positioning for comprehensive coverage and accurate tracking, regardless of the environment.

Real-time condition monitoring with minimal power use: HL7900 features a new ultra-low power sensor hub that continuously monitors specific conditions such as accelerometer data and temperature. This hub activates only when necessary for

immediate detection of critical changes, enabling prompt responses to potential issues without compromising energy efficiency.

Satellite IoT: Satellite IoT, particularly Narrowband IoT (NB-IoT) over NTN, represents a transformative leap in the asset tracking landscape. NB-IoT over NTN leverages satellite communication for IoT connectivity in areas without consistent coverage, ensuring continuous and reliable connectivity even in the most remote areas. HL781x LPWA modules support NTN communications, giving customers the option to connect using NB-IoT over a satellite network without traditional terrestrial coverage.

Cellular Managed Connectivity Services – Smart Connectivity

Semtech also operates as a full Mobile Virtual Network Operator (MVNO), offering a truly global connectivity service: AirVantage Smart Connectivity. It supports all popular LPWA, LTE, and 5G technologies. Smart Connectivity offers an intelligent, resilient global SIM, a unified connectivity management platform, and a support team with three decades of IoT experience to keep critical assets tracked and monitored globally.

One global SIM: With multi-network access over 600 operator networks spanning 190+ countries, the eSIM/eUICC equipped with two profiles ensures seamless coverage, even in countries with roaming restrictions. Real-time network outage detection, coupled with network switching, guarantees maximum uptime for your connected assets.

One management platform: Simplify and take control of your IoT deployment with easy configuration and management of all your SIMs whether from Semtech or third-party carriers. Set alerts for anomalies, automate corrective actions, or use real-time or historical data for network diagnosis. APIs ensure easy integration into your own management portal.

One IoT partner: Work with a trusted ally with over 30 years of device-to-cloud IoT experience and 365/24/7 support from skilled professionals. Our Global Network Operations Center (GNOC) keeps your applications connected, ensuring proactive alerts, and maximum uptime for peace of mind.

SONY

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Asset Tracking with ALT1350

Small size, long battery life, and multi-tier location capabilities for seamless global cellular and NTN IoT connectivity

Keeping a step ahead of your supply chain

In an increasingly complex and globalized logistics landscape, being able to accurately track assets as they move through the supply chain can be a huge advantage for businesses, unlocking new opportunities for optimization through digitalization of supply chains based on real-time data analysis.

From location to data-driven operational visibility

Next generation asset trackers requires reliable positioning indication both outdoor and indoors, but it goes well beyond location tracking and includes tracking of: Continuous environmental conditions, indications of how long a shipment has remained in a truck or warehouse, whether it has been tampered with in anyway or mishandled. This information can be used to resolve disputes, provide evidence for insurance claims or help companies make changes in their supply chains that could save money and improve efficiency.

IoT requirements for asset tracking

Asset trackers require highly optimized hardware providing low power connectivity and location transceivers to enable long battery life, in a small package and at an affordable cost. Requirements demands is increasing due to additional features required to support the overall solution such as being able to track an asset both indoor and outdoors, and keeping consistent location data flow to the cloud.

Unmatched performance in the Asset Tracking market

Sony's Altair cutting-edge cellular IoT chipset ALT1350 is an ideal one-chip solution for asset trackers, designed from the ground up for ultra-low power consumption, featuring cellular and NTN connectivity for consistent coverage, integrated SIM (iSIM), WiFi sniffing for indoor location finding and both integrated and external GNSS configurations, all in a miniature sized SiP.

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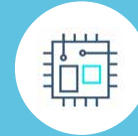
Ultra-low power consumption

Sony's Altair cellular IoT chipsets provide low-power, wide-area connectivity - maintaining the device's low-power consumption and enabling years of battery life, while offering useful data and asset location in real-time. Companies can make much smarter, data-driven decisions that help reduce cycle-times as well as loss-rates of both assets and goods.



Global multi-connectivity

Sony's Altair ALT1350 supports not only seamless cellular connectivity, but also NTN for robust coverage and reliable connectivity everywhere. To ensure multi-market and versatile carrier support, Sony's Altair breakthrough OneSKU™ RF technology enables support of any LTE band combination on a single hardware or module design. This provides module and device vendors with a truly global solution without increasing solution size or cost.



Highly integrated asset tracking chipset Platform

Sony's Altair ALT1350 was built and designed to support Asset Tracking use cases. Many new and existing use cases do not settle for outdoors GNSS based location anymore, and require also information on the asset location even indoors. That's why we've integrated WiFi sniffing capability in the chipset, so applications can track and acquire location throughout the full journey of the asset, inside or out.

In addition, different asset tracking solutions require different intervals and accuracy of the located asset. For intermittent and rough location requirements the ALT1350 supports cell-ID and integrated GNSS solution, while for more rigorous requirements, the ALT1350 supports external GNSS configuration that optimizes power and enables continuous tracking information flow to the cloud.



Fast time to market


Our all-inclusive field-proven globally certified cellular IoT chipset has passed all functional tests and is used by leading global module vendors. Customers can use a module vendor of their choice and can effortlessly migrate from one chipset to another. Our integrated SIM provides out-of-the-box connectivity and ensures rapid installation. Our accredited pre-certification lab ensures certification compliance. For all these reasons, companies can design with confidence and launch fast.



Beecham Research is a leading technology market research, analysis and consulting firm established in 1991. We have specialized in the development of the rapidly-growing Connected Devices market, often referred to as M2M and IoT, worldwide since 2001. We are internationally recognised as thought leaders in this market and have deep knowledge of the market dynamics at every level in the value chain.


Our clients include component and hardware vendors, major network/connectivity suppliers, system integrators, application developers, distributors and enterprise users in both B2B and B2C markets. We are experts in M2M/IoT services and platforms and also in IoT solution security, where we have extensive technical knowledge.

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Shaping the IoT future